SITE INVESTIGATION WORK PLAN
CHRYSLER CORPORATION
DAYTON THERMAL PRODUCTS PLANT
DAYTON, OHIO

Prepared For

Chrysler Corporation

July 1997

LEGGETTE, BRASHEARS & GRAHAM, INC.
Professional Ground-Water and Environmental Engineering Services
1210 West County Road E, Suite 700
St. Paul, Minnesota 55112

TABLE OF CONTENTS

LIST OF FIGURES
(at end of report)

SITE INVESTIGATION WORK PLAN
CHRYSLER CORPORATION
DAYTON THERMAL PRODUCTS PLANT
DAYTON, OHIO

1.0 INTRODUCTION

Leggette, Brashears & Graham, Inc. (LBG) was retained by Chrysler Corporation (Chrysler) to prepare this work plan detailing additional site investigation activities to be conducted at the Dayton Thermal Products Plant (DTPP) in Dayton, Ohio. This work plan was developed in response to a request from Chrysler.

The proposed scope of work includes installation of monitoring wells and piezometers, sampling and analyses of soil and ground water, aquifer testing, and surveying. The work will be conducted in accordance with the guidance for conducting site investigations and remediation programs as established by the Ohio Environmental Protection Agency (OEPA).

2.0 PROJECT OBJECTIVES

The objectives of this work are:

- to delineate the horizontal and vertical extent of ground water impacted by volatile organic compounds (VOCs);
- to investigate the likely existence of an off-site plume that is impacting the facility;
- to determine VOC-impacted soil source areas;
- to collect natural attenuation screening data, in order to determine if subsurface conditions are favorable for natural attenuation of target compounds;
- to determine the vertical and horizontal ground-water flow paths, gradients, and aquifer characteristics at the site;

- to document the continuity of the clay layer separating shallow impacted ground water, and deep unaffected ground water; and
- to collect data pertinent to evaluating and implementing remedial alternatives, if necessary.

3.0 SITE BACKGROUND

3.1 Site Location

The site is located at 1600 Webster Street, Dayton, Montgomery County, Ohio (figure 1). The property is approximately 60 acres in size and contains over 1.3 million square feet of building space (figures 2 and 3). The site is a manufacturing facility located in a mixed industrial/residential area. Industries in close proximity to the site include: Brainerd Manufacturing, Holman Plating, Labinal Components, and AMCA International to the west; Paint America, Sheffield Machine Tool, and W&W Molded Plastics to the south; and American Lubricants and Gem City Chemicals to the east (figure 2).

3.2 Site Topography and Hydrology

The elevation of the site is approximately 750 feet above mean sea level. The Dayton area is located in the central lowland physiographic province, which is primarily drained by the Great Miami River and its tributaries (USGS, 1966). The DTPP is located on a flat topped terrace which is an erosional remnant from the outwash of the Mad River. The terrace is bordered on the north, west, and south by flood plains of the Miami and Mad Rivers. The site is located approximately 1,500 feet southeast of the southerly flowing Great Miami River and approximately 4,500 feet northwest of the southwesterly flowing Mad River. The Mad River converges into the Great Miami River approximately 5,000 feet south of the site.

3.3 Site Summary and Conditions

The following site summaries are based upon information available to LBG. Sources of information include previously prepared reports, Chrysler representatives, aerial photographs, and personal communications with persons knowledgeable of the site and surrounding area.

The property was first developed as a manufacturing plant in approximately 1907. Maxwell cars were assembled at the facility. Chrysler purchased the property in 1936. Activities conducted at the plant have included light machining, plating, metal stamping, welding, soldering, degreasing, painting, plastic molding, and assembly and packaging. Some of the products produced at the facility included furnaces, air conditioners, cars, aluminum and copper tubing, fire products, gun parts, bomb shackles, and plastic molding.

Currently, operations at the facility include the manufacture, assembly, and finishing of heat exchangers and air conditioning components for motor vehicles. The facility consists of eight manufacturing buildings, a powerhouse, wastewater treatment plant, and associated storage buildings (Clean Tech, 1995).

On November 19, 1987, while cutting a hole in the concrete flooring for a guard post in Building 40B, liquid began to seep into the hole. Analysis of the liquid using gas chromatography/mass spectrometry (GC/MS) indicated the presence of VOCs. Compounds detected in the liquid included 1,1- dichloroethane, 1,1-dichloroethene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, trichloroethene (TCE), tetrachloroethane, 1,2-dichlorobenzene; cis-1,2,-dichloroethene, and methyl ethyl ketone.

In November of 1989, the OEPA made an unannounced RCRA (Resource and Conservation Recovery Act) inspection of the plant. While there, the OEPA requested that the plants two water-supply wells (Well 2 and Well 3) be sampled. The wells provide cooling water for the powerhouse equipment. Well 2 is located in Building 39 (Boiler House) and Well 3 is located adjacent to the northeast corner of Building 50. Analytical data for the ground-water sample collected from Well 2 indicated the presence of numerous VOCs similar to those noted above. No VOCs were detected in the ground-water sample collected from Well 3. Well 2 has a total depth of 79 feet while Well 3 is 136 feet deep. Historically, another well (Well 1) was located in Building 40A. It is our understanding that this well is abandoned.

In 1990, the Maxwell Complex, consisting of twelve buildings, was demolished and a new structure (Building 59) was constructed in its place. During the demolition, an oily material was observed seeping from the east foundation of Building 40B. Additionally, impacted soils were noted beneath concrete slabs, sewer lines, process pipelines and sumps, waste storage pad, oil/water separator, TCA tank and other areas including the footprint of Building 59. Soil samples collected during the demolition and construction indicated the presence of VOCs and total petroleum hydrocarbons (TPH). Soils excavated from the various areas noted above were segregated according to the compound class present (TPH versus VOCs) and were either transported to a proper disposal facility or stockpiled on site. The stockpiled soils were subsequently treated by vapor extraction beds (John Mathes & Associates, Inc., June 1991).

Following the soil excavation, a site wide reconnaissance evaluation was undertaken. Testing included 167 soil-gas samples, 28 ground-water headspace samples, and 23 ground-water samples. The results of this investigation are summarized in a previous report (Clean Tech, February 1994).

3.4 Regional Geology

The regional geology of the Dayton, Ohio area has been examined and discussed by several authors. Original publications by Norris (1959) and Walton and Scudder (1960) were reviewed. Site investigations by QSource Engineering, Inc. (1993) for Gem City Chemicals, Inc. facility, and by John Mathes & Associates, Inc. (1991) for the DTPP property incorporate these and several additional previous studies. The regional geology of the area has been summarized here from these information sources.

The regional geologic setting of the Dayton, Ohio area consists of glacial and glacial-fluvial (outwash stream) sediments deposited over an irregular bedrock surface. Highly permeable calcareous sands and gravel fill pre-glacial or glacial valleys eroded into the underlying bedrock. These permeable glacial deposits are believed to be outwash deposits originating from retreating glaciers. The permeable deposits have formed shallow and deeper aquifers separated by low permeability confining layers. The confining layers are till layers composed primarily of clay with mixtures of gravel, sand, and silt.

The bedrock underlying the glacial sediments is believed to consist of relatively impermeable materials. It is mapped as the Ordovician Richmond Group, and is composed of soft, light gray, calcareous shale with interbedded layers of limestone. Few wells in the region have reached the bedrock surface, which is estimated to be 250 to 300 feet below grade (bg) in most areas. The bedrock yields little to no water, provides little recharge to the overlying aquifers, and acts as an impervious layer and lateral boundary to the overlying aquifers.

Regional studies of the glacial and glacial-fluvial deposits have shown the uppermost recognizable geologic unit is a sand and gravel outwash deposit approximately 80 feet thick. This unit is typically recognized as the unconfined aquifer. Discontinuous till layers have been encountered within this unit at depths between 40 and 50 feet bg.

The unconfined aquifer is generally underlain by a till layer present at approximately 80 feet bg. This till layer appears to be laterally persistent, but may be absent from some locations in the region due either to non-deposition or erosion. Till layers have been reported as massive clay units, or as zones of alternating clay with stratified sand and gravel. Till layers act as confining layers which control aquifer recharge and regional ground-water flow.

Regional studies indicate that a second recognizable sand and gravel outwash deposit underlies the till layer found at approximately 80 feet bg. This lower aquifer behaves as a confined or semi-confined aquifer. However, if the till layer is thin or absent, the hydraulically connected sand and gravel units act as a single unconfined aquifer.

Deep wells in the region suggest discontinuous till layers may exist within the second glacial outwash unit (the semi-confined aquifer), and additional semi-confined or confined aquifers exist at greater depths. These deeper aquifers are believed to be separated by till layers in much the same way as the shallower geologic units.

3.5 Site Geology

The DTPP site geology consists primarily of sand and gravel with minor amounts of silt and clay. These are the glacial and glacial-fluvial sediments typical of the region. The sand and gravel is interbedded with till and clay layers composed of massive clay units, or zones of clay with sand and gravel. The uppermost 2 to 4 feet is typically a disturbed clay-bearing material which is absent in many places, probably due to site development activities. None of the previously advanced borings or wells reached the bedrock surface. The uppermost geologic unit at the site is a sand and gravel outwash deposit approximately 75 to 90 feet thick. This is the unconfined aquifer. Clay units, and units composed of clay, sand and gravel mixtures were encountered within the unconfined aquifer. Several of these units are laterally persistent suggesting they might exert some local control over potential contaminant migration pathways. Additional clay-bearing units were noted in the unconfined aquifer, but were restricted to certain small areas of the site. A persistent till layer was encountered, which was interpreted as forming the confining layer between the unconfined aquifer and the underlying semi-confined aquifer. The thickness of the till ranged from 15 to 25 feet thick. The approximate depth to the top of the till layer ranged from 44 to 90 feet.

The semi-confined aquifer was encountered below the till layer. It consists of sand and gravel with minor amounts of fine-grained material, much like the unconfined aquifer. These materials are glacial and glacial-fluvial sediments typical of the region. The monitoring wells penetrated approximately 20 feet of the uppermost portion of the unit. No clay-bearing units were noted in the portion of the semi-confined aquifer examined. Driller's logs for water-supply Wells 3 and 4 describe the unit as coarse grained sand and gravel. A till layer was encountered in water-supply Well 3 between 128 and 129 feet bg.

During previous investigation activities, well drillers were quick to recognize naturally-occurring hydrocarbons from clays within the unconfined aquifer, and from the till underlying the unconfined aquifer. The hydrocarbons were described as a dark brown liquid. The free-phase product was noted in drill cuttings, when bailing during cable tool drilling, and during examination of soil samples. Such till layers in the region are known to contain significant amounts of natural hydrocarbons, as confirmed by the State of Ohio Geological Survey (Survey). In fact, the Survey noted that a major oil company had recently studied the viability of hydrocarbon production from till layers in the region.

4.0 SCOPE OF WORK

In order to meet the project objectives, the following tasks will be conducted:

- advance soil borings and install up to 26 on-site monitoring wells/piezometers;
- advance soil borings and install up to nine off-site monitoring wells/piezometers in the road right-of-way on Leo Street;
- collect soil samples and screen for VOCs in an on-site mobile laboratory;
- select soil samples based on screening results and submit to an Ohio-certified laboratory for VOC analysis via EPA Method 8260;
- collect water samples while drilling via Hydropunch or similar method, and screen for VOCs in an on-site mobile laboratory;
- develop all new monitoring wells/piezometers and purge all existing monitoring wells/piezometers;
- collect a round of fluid-level measurements and collect ground-water samples from all new and existing monitoring wells/piezometers;

? are We confident of the contents

- submit ground-water samples to Ohio-certified laboratory and analyze for VOCs via EPA Method 8260;

Though C.C.

- collect and analyze soil and ground-water samples for natural attenuation parameters;

Why over pump test

- conduct slug tests in selected monitoring wells/piezometers;
- survey the location and elevation of all new and existing monitoring wells/piezometers; and
- properly characterize and dispose of wastes generated from drilling and sampling activities.

4.1 Utility Clearance

Prior to conducting any field activities, LBG will notify Diggers Hotline or equivalent for the identification and marking of all underground utilities present at proposed drilling locations. LBG will also contact the City of Dayton Sewer and Water Department to document the location of water lines, sanitary sewers, and storm sewers in the vicinity of the site.

4.2 Site Health and Safety Plan

Prior to conducting field investigation activities, LBG will prepare a site-specific health and safety plan. The plan will address the health and safety issues associated with the planned activities. It is anticipated that Level D protection will be adequate for the field investigation. The safety plan will be distributed to, and reviewed with, all field personnel prior to commencing field activities.

4.3 Site Investigation and Characterization

The objectives of this site investigation phase is to define the vertical and horizontal extent of impacted ground water and soils at the site and to identify potential source area(s). Additional objectives include determining aquifer characteristics, evaluating potential migration pathways, and obtaining sufficient information to recommend remedial alternatives, if required. This task will include vertical ground-water profiling, advancement of soil borings, collection and analysis of discrete soil samples, installation of monitoring wells and piezometers, collection and analysis of ground-water samples, and performance of slug tests in selected wells.

Based on average concentrations of VOCs in ground water from two previous sampling events, compared to the ground-water Interim Standards established for this site, the following analytes are identified as compounds of concern: tetrachloroethene, TCE, benzene, 1,2-dichloroethene (total), cis-1,2,-dichloroethene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, chloroform, 1,2-dichloroethane, 1,1-dichloroethene, vinyl chloride, 1,1,1,2-tetrachloroethane, and chloroethane.

Based on previous investigation results and findings, the need for additional well clusters is clear. Well clusters previously installed consist of shallow, intermediate, and deep wells. The shallow well screens are located at or near the water table. Intermediate well screens are installed at the top of the first significant clay layer while the deeper wells are screened below the till layer. It should be noted that not all intermediate wells encountered the clay layer. Historical subsurface data indicates the greatest impact to ground water is in the shallow wells, with lesser concentrations of VOCs detected in some intermediate wells. No VOCs have been detected in the deep wells. Therefore, LBG recommends that additional well clusters be installed which do not breach the clay layer. Well depths will be dependant on site conditions and field screening results.

LBG anticipates the installation of approximately 35 monitoring wells/piezometers in 20 locations, subject to actual field observations and results. Four clusters will be located upgradient of the site on the south side of Leo Street to determine if impacted ground water is migrating onto the property from an off-site source. The other wells will be located on site at locations designed to fill in data gaps, and next to shallow wells where the vertical extent of contamination has not yet been defined. The deeper wells will also serve to determine the continuity of the clay layer beneath the site.

Proposed well locations are shown on figure 4, which also illustrates the known extent of TCE dissolved in ground water. Figures 5 through 8 show cross-sectional views of the TCE plume and the proposed well and piezometer locations.

4.3.1 Vertical Profiling of Soil and Ground Water

LBG recommends the use of a Hydropunch and an on-site mobile field laboratory for determining the vertical extent of impacted ground water. Vertical profiling can provide useful data regarding the vertical distribution of target compounds, particularly those denser than water. Field screening of soil and ground-water samples will be conducted using a programmable gas chromatograph (GC) with a photoionization detector (PID) and flame ionization detector (FID) operated in series. Field screening results of the soil and ground-water samples will be utilized in conjunction with stratigraphic observations and previous data to locate wells/piezometers and to determine screen setting depths.

In general, soil and ground-water samples will be collected at 5 and 10-foot depth intervals, respectively, to the termination of each boring. Additional samples may be collected on the basis of lithologic significance and/or data from previous borings indicating a potential for the presence of VOCs. When two borings are located in close proximity to one another (i.e. nested), samples will be collected only from the deepest boring.

4.3.2 Soil Boring Specifications

The borings will be installed using the hollow-stem auger method. Split-spoon samples will be collected every 5 feet, from grade to the total depth of the boreholes. The samples will be collected using a 2-inch diameter by 2-foot long, split-spoon sampler driven ahead of the auger bit. Split-spoon sampling equipment will be decontaminated between each sample interval. Immediately upon opening the split-spoon sampler, the length of the sediment sample will be screened with a PID. A discrete sample will then be collected and split. One split sample will be field screened for VOCs in the on-site mobile laboratory and the other split sample will be retained in a laboratory-supplied sample jar, on ice, for possible off-site laboratory analysis.

The sample interval exhibiting the highest screening concentration from each boring will be submitted to an Ohio-certified laboratory for VOC analysis via EPA Method 8260. If no samples exhibit headspace PID readings above background, the sediment sample corresponding to the depth of the water table will be submitted for analysis. Additional samples may also be submitted on the basis of visible staining, stratigraphic significance, or PID readings. A minimum of three soil samples exhibiting "non-detect" PID readings will also be submitted for analysis in order to establish background level soil quality. A minimum of one representative split-spoon sediment sample from each soil boring location will be placed in labeled, 1-pint, Mason-type jars for possible future sieve analysis. In order to determine if subsurface conditions are conducive to favorable rates of natural attenuation of target compounds, LBG will also collect additional soil samples for analyses of total organic carbon. All soil cuttings will be containerized, or stockpiled on and covered with plastic sheeting on site until proper disposal methods are clarified.

All sediment samples will be classified and described by the LBG hydrogeologist on site. Field boring logs will include information such as the boring location, drilling methodology, sample depth, sediment type, texture, color, grain size, induration, moisture content (qualitative) and any other pertinent observations.

4.3.3 Monitor Well/Piezometer Construction Specifications

All wells/piezometers will be constructed in accordance with OEPA monitoring well and piezometer construction requirements. Wells/piezometers will be constructed of 2-inch diameter, Schedule 40 PVC. Monitoring well screens are anticipated to be 10 feet in length. Piezometer screens will be 2 feet long. In addition, all newly installed wells will be developed in accordance with OEPA rules and regulations. Development water will be containerized for proper disposal.

In the event that wells are located within traffic areas or in areas where wells might be susceptible to damage from snow removal equipment, the wells will be constructed as flush-grade wells. These wells will terminate approximately 2 inches abovegrade and will be protected in a water-tight vault installed in a concrete pad. The pad will have minimum dimensions of 3 x 3 feet with a minimum thickness of 4 inches and will have a finished grade sloped to divert water away from the well.

Following installation, well-casing elevations and the elevation of the ground surface at each well location will be surveyed by a licensed/certified surveyor and referenced to mean sea level. The location of each well will also be surveyed and referenced to previous site survey information.

4.3.4 Monitor Well/Piezometer Sampling and Analyses

Prior to obtaining ground-water samples for laboratory analysis, fluid levels will be measured in each well to within 0.01 foot using a clean steel tape or electronic water-level indicator. Measurements will be taken from the surveyed reference mark on top of the inner well casings. The wells will then be purged in accordance with OEPA's ground-water sampling guidelines. All samples will be obtained using either clean, disposable or stainless-steel bailers and new rope, a pump, or other appropriate methodology. All purging, pump, and fluid-level measuring equipment will be properly and thoroughly decontaminated between sampling locations.

Ground-water samples will be submitted to an Ohio-certified laboratory for VOC analysis via EPA Method 8260. In order to determine if subsurface conditions are conducive to favorable rates of natural attenuation of target compounds, LBG will also collect additional ground-water samples for analyses of semi-volatile organic compounds, total organic carbon, nitrate, nitrite, sulfate, sulfide, iron (II), iron (III), manganese (II), manganese (IV), methane, ethane, ethene, hydrogen, carbon dioxide, pH, alkalinity, and chloride. LBG will also measure temperature, dissolved oxygen, and oxidation/reduction potential in all site wells/piezometers.

4.3.5 Slug Testing

LBG will conduct in-situ permeability (slug) tests following development and/or purging and sampling of selected monitoring wells/piezometers. The slug tests will provide values for hydraulic conductivity of the sediments in the vicinity of the well screen. The tests will be performed using a pressure transducer connected to a portable datalogger. The transducer will be lowered into the well, submerged, and a static water level will be recorded. Tests will be conducted by either "instantaneously" adding a known volume of distilled water or by submerging a solid object (slug) into the well. As the water level recovers to static conditions, the water level change over time will be recorded. In wells in which the well screen transects the water table, a slug-out test will be conducted. Once static water levels are reached after submerging the slug, the slug will be "instantaneously" removed from the well and water levels will be recorded until static conditions are reached. Tests will be repeated at selected wells to assure that results are reproducible. The change in water level over time will be plotted and used to derive a formation hydraulic conductivity using the Bouwer and Rice (1976) or other appropriate method.

5.0 QA/QC, CHAIN-OF-CUSTODY PROCEDURES

To assure the integrity and validity of the analytical results, field, trip, and bailer blanks, along with duplicate samples, will be collected and analyzed. A laboratory-prepared trip blank will be transported to the site and returned to the laboratory in a manner identical to the handling procedure used for the samples. These trip blanks will be subject to the same analysis as the ground water. Bailer blanks will be prepared in the field by filling a bailer with deionized water and transferring the water to a sample vial. The bailer blank will then be transferred to the laboratory with the samples for analysis. A minimum of one bailer blank will be collected during each day that monitor wells are sampled.

All soil and water samples will be placed immediately on ice and delivered to a laboratory in sealed coolers for analyses. Strict chain-of-custody procedures will be adhered to at all times for all sampling, shipment, and analytical procedures.

One field blank and one duplicate sample will be collected/submitted for every group of ten or less water samples. One trip blank will be included for each batch of water samples submitted for VOC analyses.

The analytical accuracy and laboratory precision will be monitored by the analysis of matrix spikes and duplicate samples, and by adherence to the laboratory's quality assurance/quality control requirements as detailed in their QA/QC Control Manual.

All field instruments will be field calibrated, once in the morning, and again in the afternoon. Additional calibrations may be performed as field conditions warrant. Daily activity logs will be kept and maintained, and will include documentation of field activities, such as: field screening results, sampling procedures, work activities, and a log of all routine and non-routine maintenance and calibrations performed on all instruments used during the field investigation.

6.0 SCHEDULE

6.1 Work Completion

LBG is prepared to initiate the project upon receipt of Chrysler's written authorization to proceed. LBG anticipates that the work will require approximately 10 weeks to complete.

6.2 Reporting

Throughout the duration of this project, LBG will maintain communications with Chrysler and the OEPA to facilitate dissemination of pertinent information and findings.

These communications will be accomplished via on-site meetings, telephone, fax, mail, and/or overnight carrier. LBG will prepare and submit a draft site investigation report to Chrysler within 45 days of receipt of laboratory analytical results.

LEGGETTE, BRASHEARS & GRAHAM, INC.

Kenneth D. Vogel, CPG, CHMM
Associate

David V. Strand, CPG
Hydrogeologist II

Reviewed by:

J. Kevin Powers
Vice President

DVS/KDV:kw
July 28, 1997
S:\TECH\3CHRY\DAYTON\INPROG\WKPLN.RPT

REFERENCES

Bouwer, H. and Rice, R. C., 1976, "A Slug Test For Determining Hydraulic Conductivity For Partially Penetrating Wells," Water Resources Research, Vol. 12, No. 3, p. 423-428.

Clean Tech, Inc., "Site Assessment Summary," February 1994.

Clean Tech, Inc., "Site Investigation, Chrysler Corporation Dayton Thermal Products Plant, Dayton, Ohio," September 1995.

John Mathes & Associates, Inc., "RECON Investigation Dayton Thermal Products Division, Dayton, Ohio," June 28, 1991.

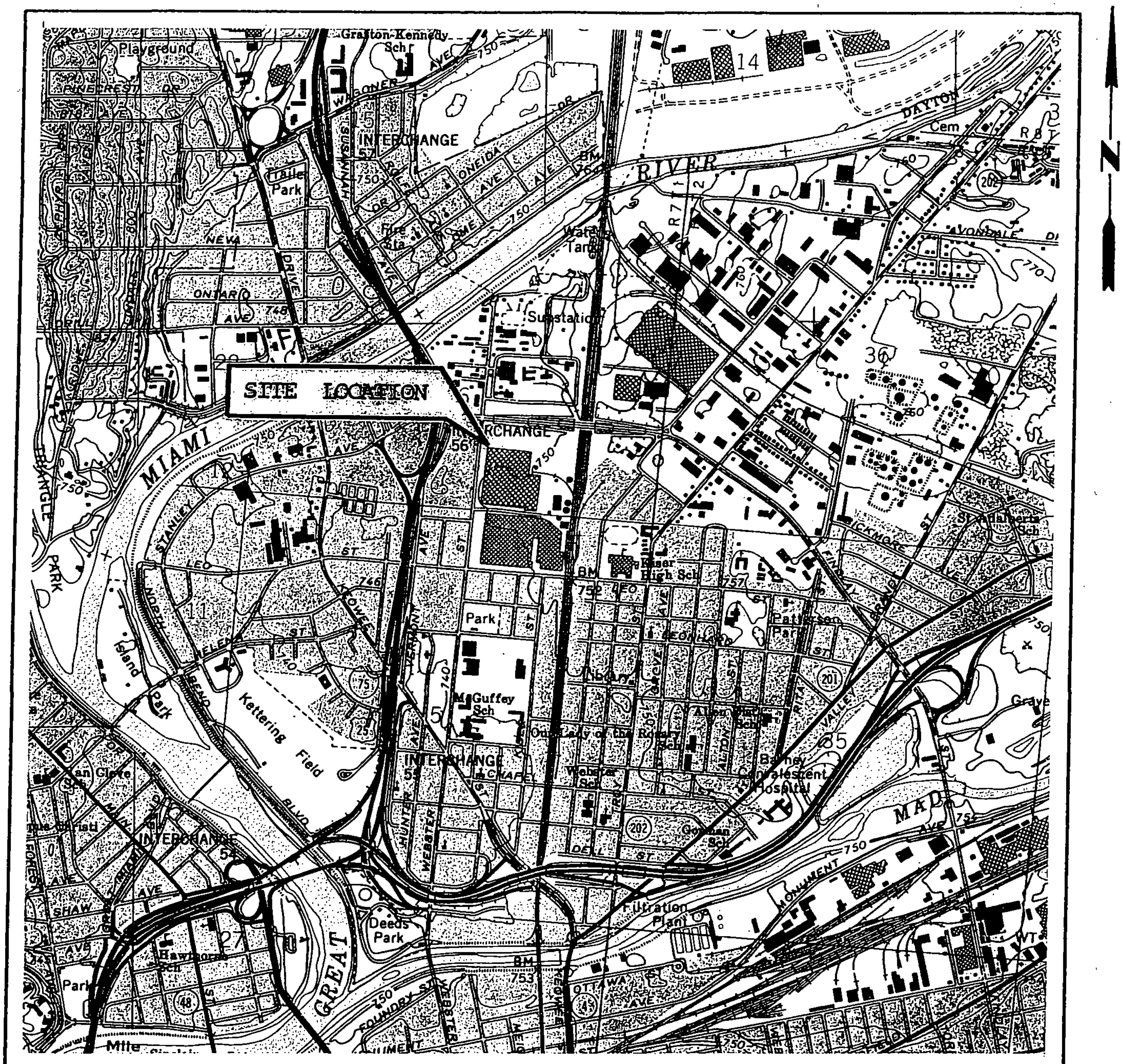
QSource Engineering, Inc., "Revision of the Site Assessment Report for Gem City Chemicals, Inc., Dayton, Ohio," July 1993.

State of Ohio Department of Natural Resources, Division of Water, GW.C. Walton and G.D. Scudder, 1960, "Ground-Water Resources of the Valley-Train Deposits in the Fairborn Area, Ohio."

U. S. Geological Survey, S.E. Norris, Vertical Leakage Through Till as a Source of Recharge to a Buried-Valley Aquifer at Dayton, Ohio," 1959.

draft

FIGURES



0 2000

SCALE IN FEET

DRAFT

QUADRANGLE LOCATION

U.S.G.S. TOPOGRAPHIC

DAYTON NORTH, OHIO

7.5 MINUTE QUADRANGLE

DAYTON THERMAL PRODUCTS PLANT

DAYTON, OHIO

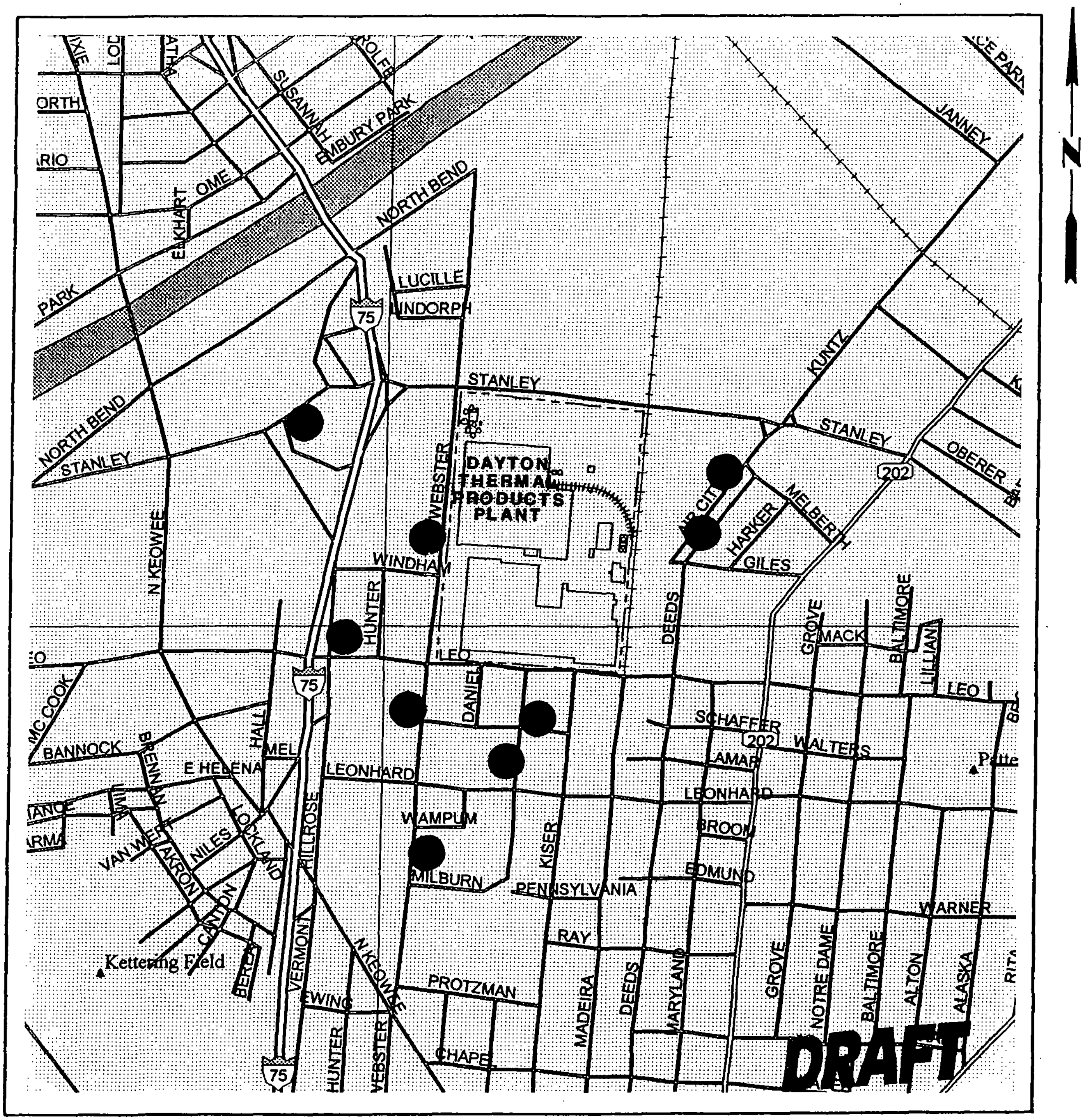
AREA LOCATION MAP

DATE	REVISED
FILE:	

PREPARED BY:

LEGGETTE, BRASHEARS & GRAHAM, INC.
Professional Ground-Water and Environmental Services
Northpark Corporate Center
1210 W. County Road E, Suite 700
St. Paul, MN 55112
(612) 490-1405

DATE: JULY 1997 | FIGURE: 1



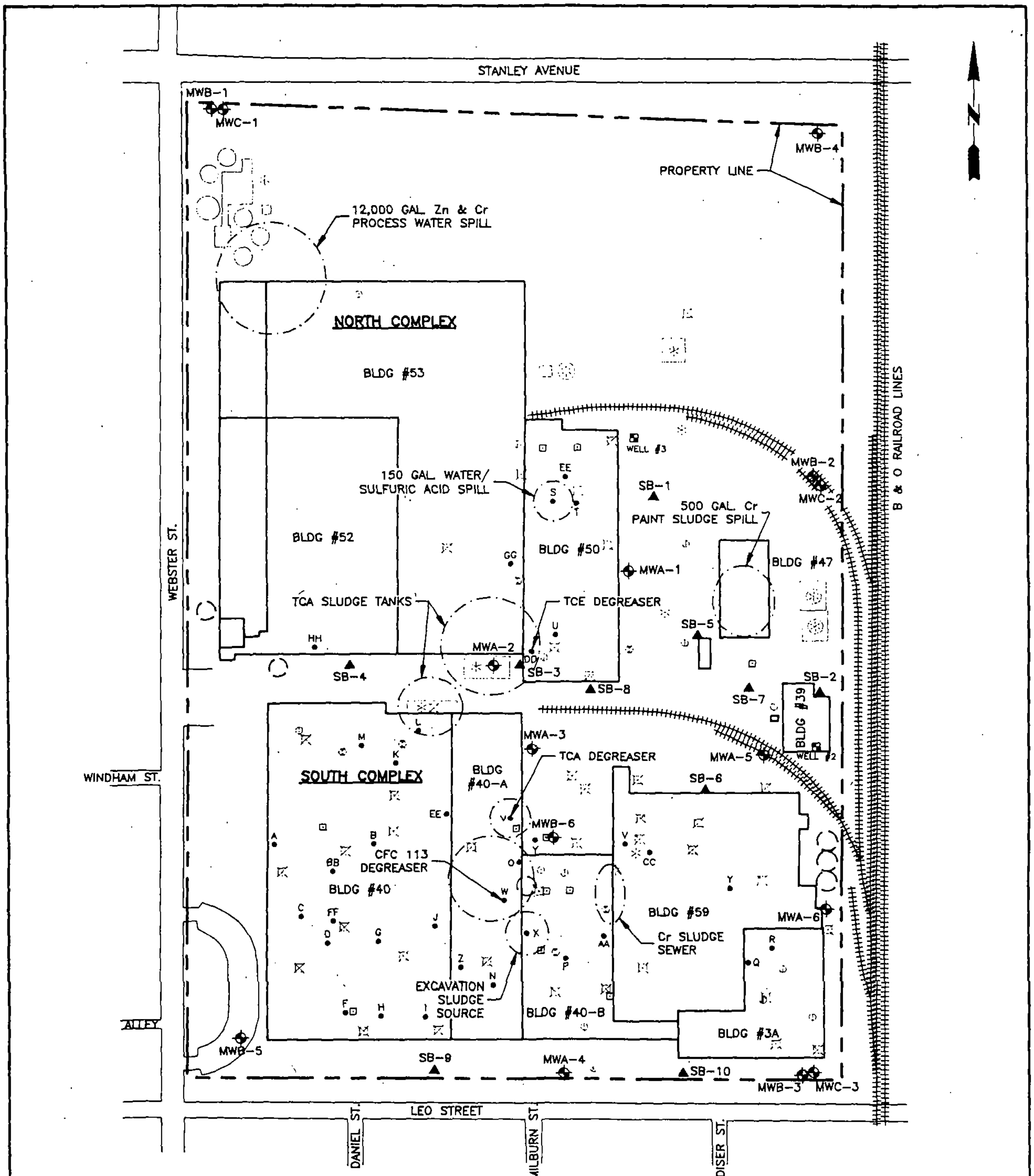
LEGEND

● NEARBY FACILITIES

SOURCE:
DELORME STREET ATLAS USA

0 1,000
SCALE IN FEET

DAYTON THERMAL PRODUCTS PLANT DAYTON, OHIO		
SITE LOCATION MAP		
DATE	*REVISED*	*PREPARED BY:* LEGGETTE, BRASHEARS & GRAHAM, INC. Professional Ground-Water and Environmental Services Northpark Corporate Center 1210 W. County Road E, Suite 700 St. Paul, MN 55112 (612) 490-1405
FILE:		*DATE:* JULY 1997 *FIGURE:* 2



DRAFT

LEGEND

- WELL LOCATION
- SOIL BORING LOCATION
- WATER SUPPLY WELL
- PROCESS WASTEWATER SUMP
- WASTE OIL SUMP
- HAZARDOUS WASTE GENERATION OR ACCUMULATION AREA
- UNDERGROUND STORAGE TANK
- ABOVE GROUND STORAGE TANK AREA
- INDUSTRIAL CLEANING SOLUTION TANKS (250-500 GALLON)
- F• PROCESS UNIT & LOCATION
- POSSIBLE SOURCE AREA

SOURCE: CLEAN TECH, INC.

0 200
APPROX. SCALE IN FEET

PROCESS EQUIPMENT DESCRIPTION

A FIRST IMPREGNATION, LOCTITE SYSTEM
B SHAFT ASSEMBLY
C WEST COOLANT PIT
D CARGILL WASHER
E PISTON WASHER
F SOUTH SHELL WASHER
G EAST COOLANT PIT
H SOUTH COOLANT PIT
I SECOND IMPREGNATION, LOCTITE SYSTEM
J NORTH COOLANT PIT
K SHAFT WASHER
L CLUTCH RETAINER WASHER
M STEEL MACHINING COOLANT PIT
N PHOSPHATING WASHER
O CLEANER TANKS
P PAINT BOOTH
Q PAINT BOOTH
R NEW WASHER
S WASHER TANKS
T CLEANER TANKS
U FLUSH WASHER SYSTEM
V MANPRO DEGREASER
W PLATE/FIN EVAPORATOR DEGREASER
X PARTS DEGREASER
Y PLATING OPERATION
Z SWASHPLATE HEAT TREATMENT MACHINE
AA NEW DETRIX DEGREASER
BB COMPRESSOR PARTS DEGREASER
CC DIP TANK
DD DEGREASER
EE DETREX DEGREASER
FF FREON DEGREASER
GG XYLOL-BASED PAINT BOOTH
HH VAPOR DEGREASER

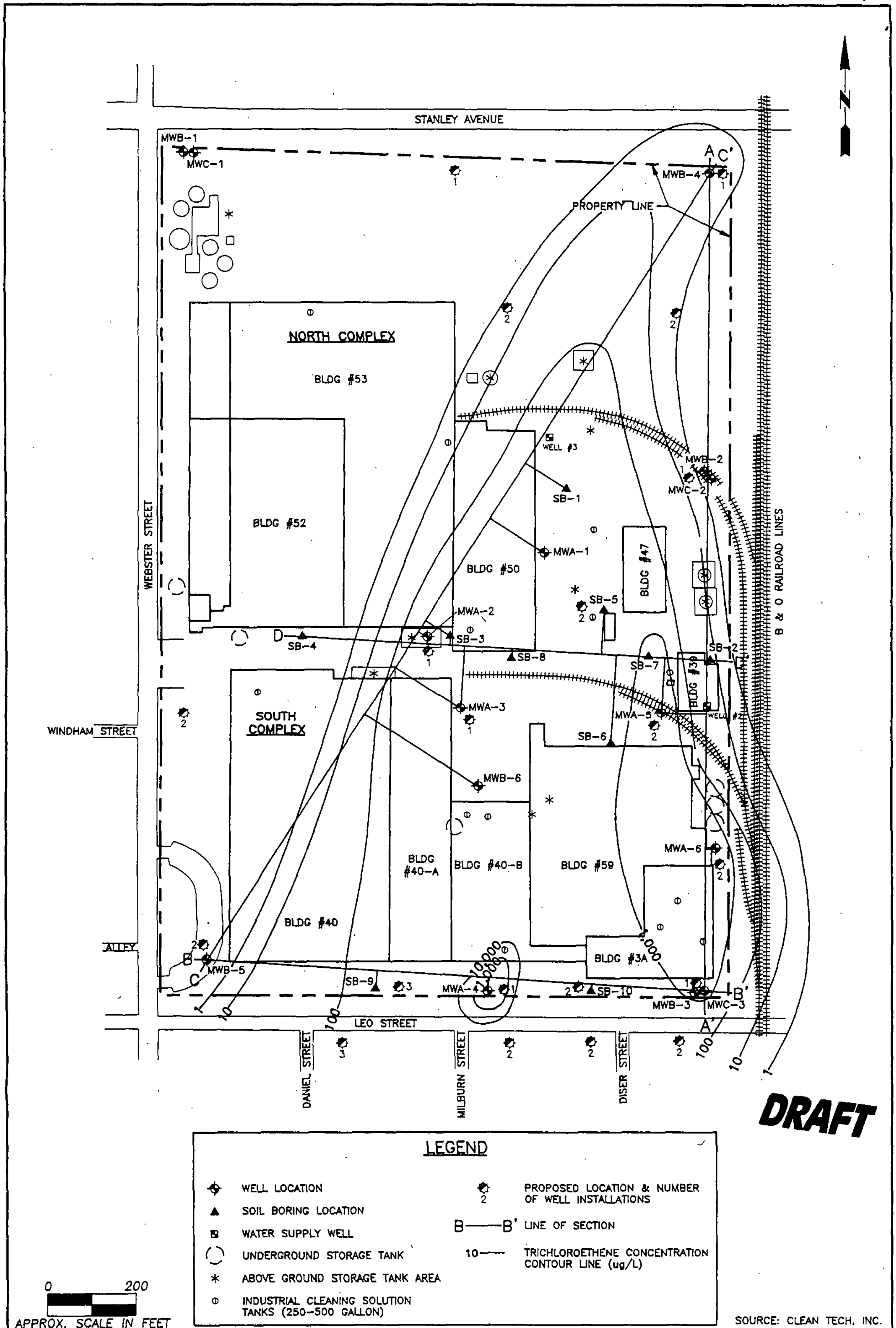
DATE	REVISED

Prepared By:
LEGGETTE, BRASHEARS & GRAHAM, INC.
Professional Ground-Water and Environmental Services
Northpark Corporate Center
1210 W. County Road E, Suite 700
St. Paul, MN 55112
(612) 490-1405

DAYTON THERMAL PRODUCTS PLANT
DAYTON, OHIO

SITE MAP

FILE: 3CHDA021.DWG | DATE: JULY 1997 | FIGURE: 3



DATE	REVISED

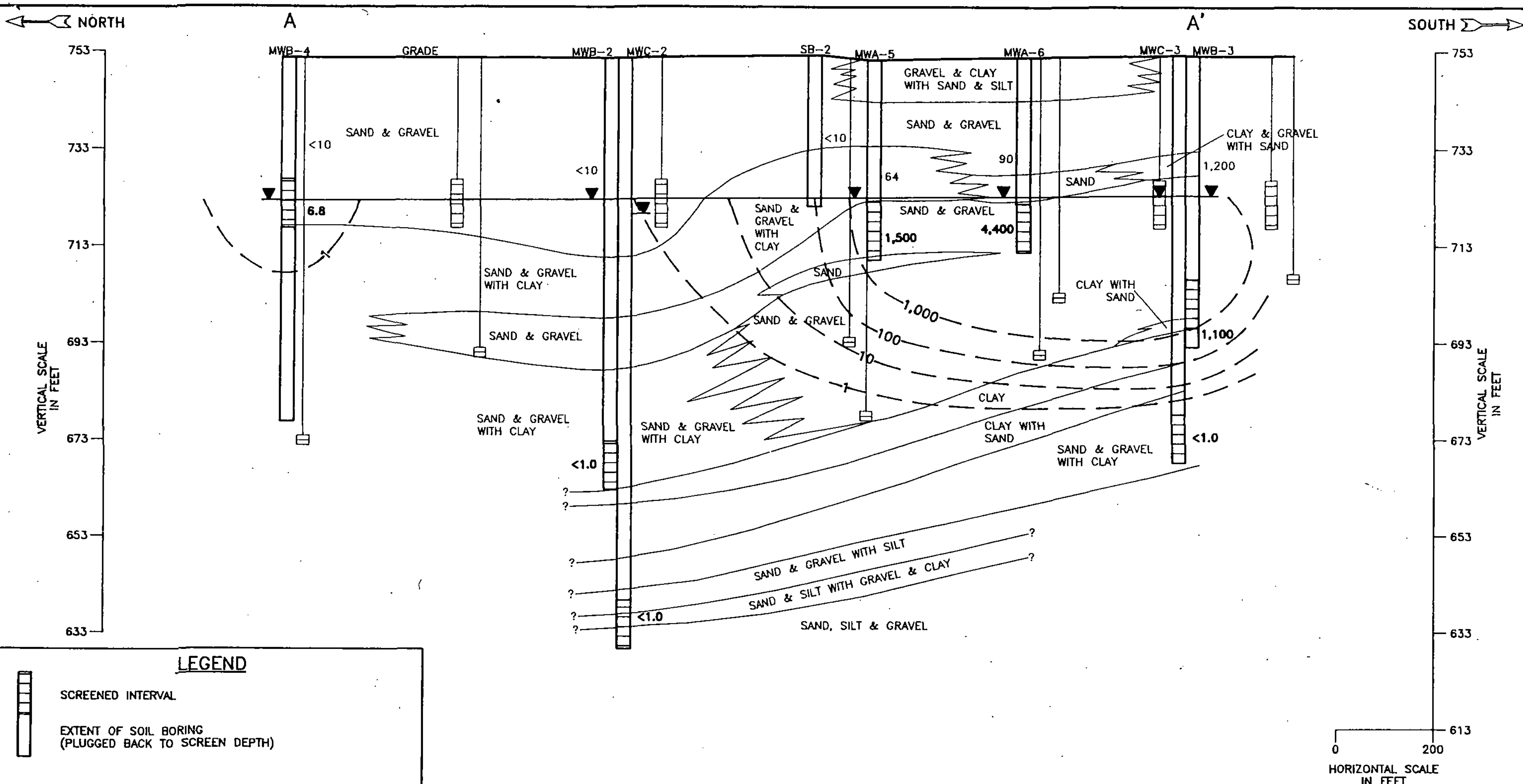
Prepared By:

LEGGETTE, BRASHEARS & GRAHAM, INC.
Professional Ground-Water and Environmental Services
Northpark Corporate Center
1210 W. County Road E, Suite 700
St. Paul, MN 55112
(612) 490-1405

DAYTON THERMAL PRODUCTS PLANT
DAYTON, OHIO

PROPOSED BORING/WELL LOCATIONS

FILE:	3CHDA02H.DWG	DATE:	JULY 1997	FIGURE:	4



LEGEND

- SCREENED INTERVAL
- EXTENT OF SOIL BORING (PLUGGED BACK TO SCREEN DEPTH)
- WATER TABLE ELEVATION (2/20/95)
- 64 TRICHLOROETHENE DETECTED IN SOIL (ug/KG) OCTOBER/NOVEMBER 1994
- **1,400** TRICHLOROETHENE DETECTED IN GROUND-WATER (ug/L) FEBRUARY 1995
- PROPOSED BORING/WELL LOCATION

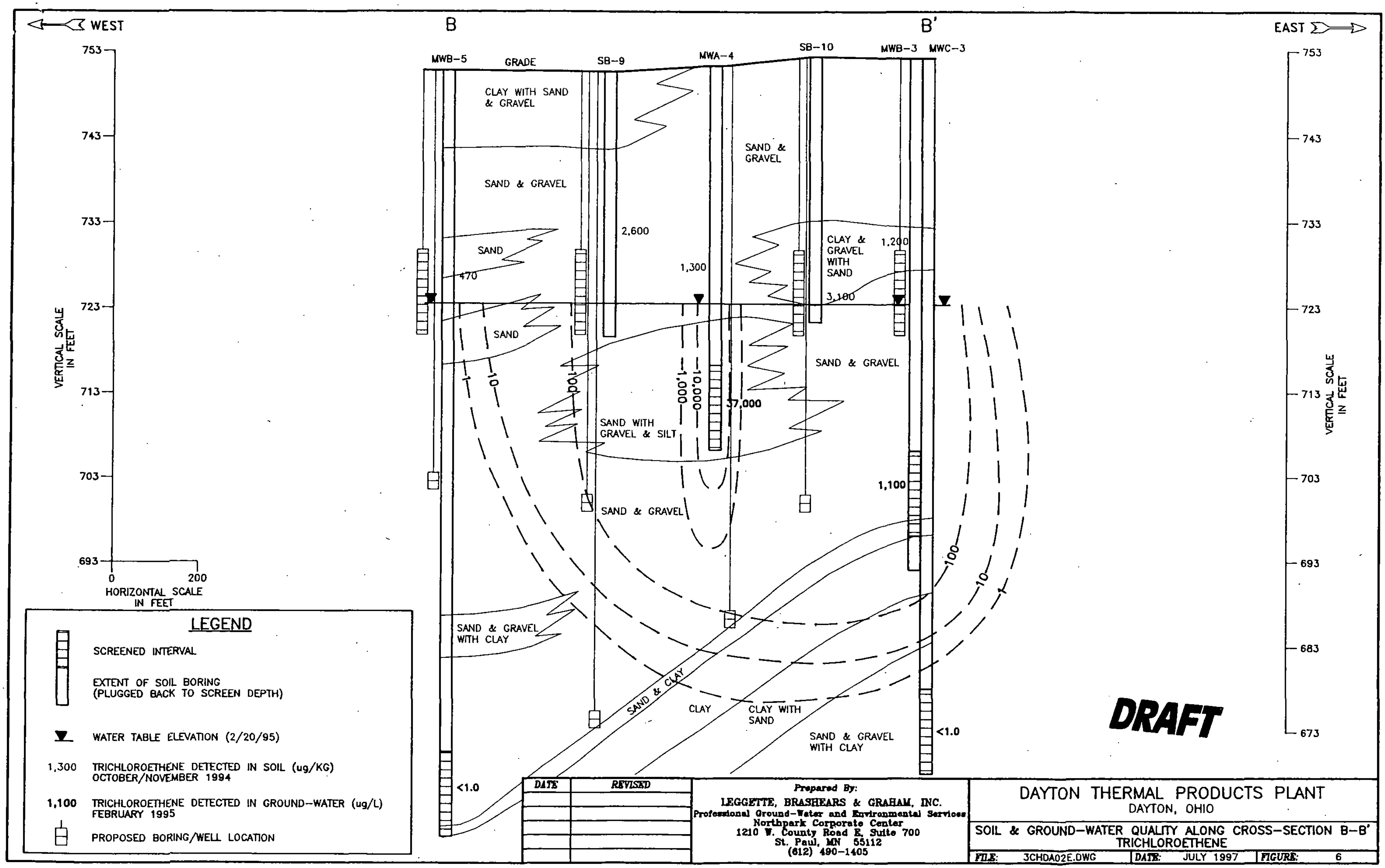
DATE	REVISED

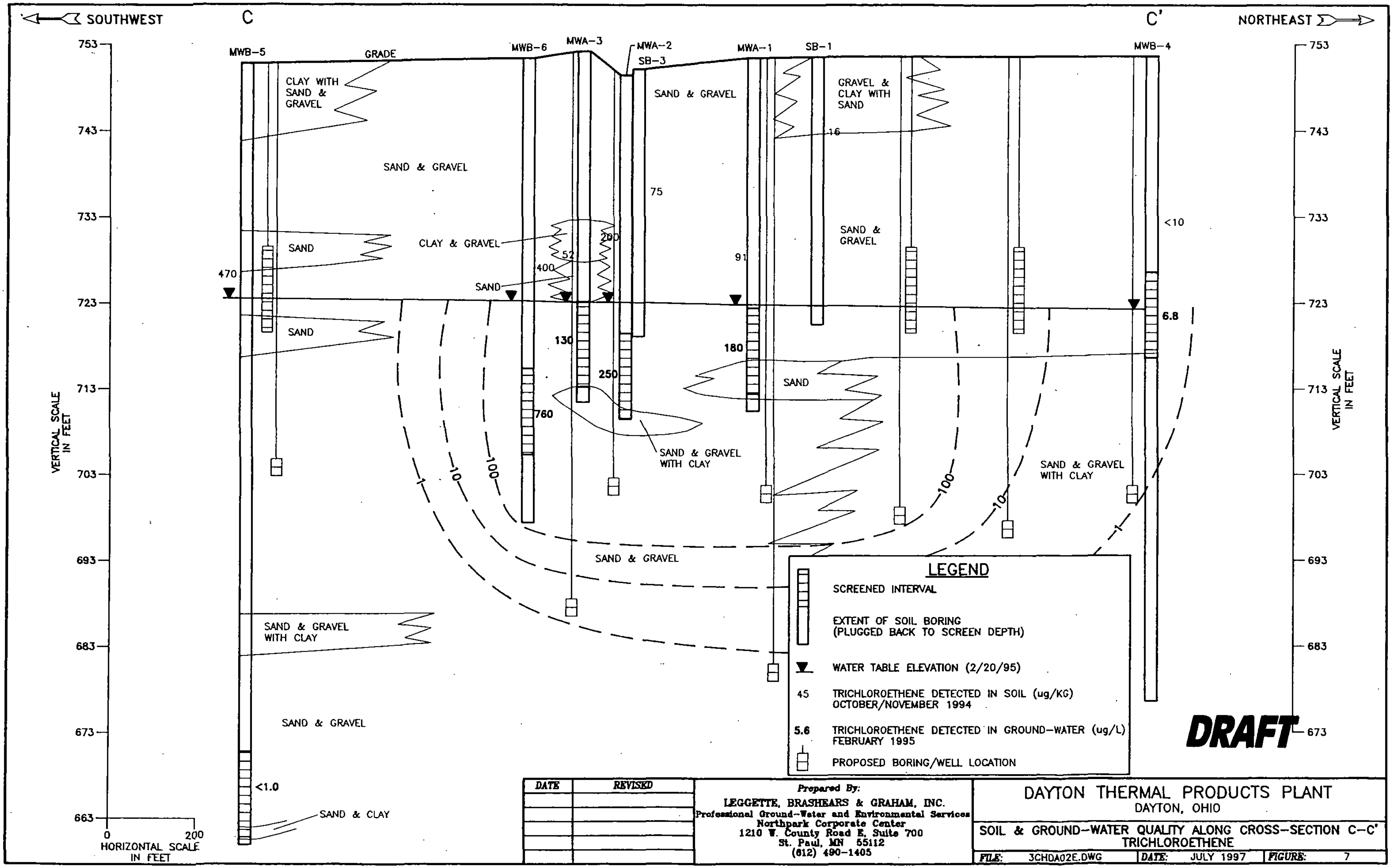
Prepared By:
LEGGETTE, BRASHEARS & GRAHAM, INC.
Professional Ground-Water and Environmental Services
Northpark Corporate Center
1210 W. County Road E, Suite 700
St. Paul, MN 65112
(612) 490-1405

DAYTON THERMAL PRODUCTS PLANT
DAYTON, OHIO

SOIL & GROUND-WATER QUALITY ALONG CROSS-SECTION A-A'
TRICHLOROETHENE

FILE:	3CHDA02E.DWG	DATE:	JULY 1997	FIGURE:	5


WEST
EAST
B
B'
VERTICAL SCALE IN FEET
753
743
733
723
713
703
693
683
673
0
200
HORIZONTAL SCALE IN FEET
MWB-5
GRADE
SB-9
MWA-4
SB-10
MWB-3
MWC-3
CLAY WITH SAND & GRAVEL
SAND & GRAVEL
SAND
470
2,600
1,300
CLAY & GRAVEL WITH SAND
1,200
3,100
SAND
SAND & GRAVEL
SAND WITH GRAVEL & SILT
37,000
1,100
SAND & GRAVEL
SAND & GRAVEL WITH CLAY
SAND & CLAY
CLAY
CLAY WITH SAND
SAND & GRAVEL WITH CLAY
<1.0
<1.0
1
10
100
1,000
10,000
DRAFT
LEGEND
SCREENED INTERVAL
EXTENT OF SOIL BORING (PLUGGED BACK TO SCREEN DEPTH)
WATER TABLE ELEVATION (2/20/95)
1,300 TRICHLOROETHENE DETECTED IN SOIL (ug/KG) OCTOBER/NOVEMBER 1994
1,100 TRICHLOROETHENE DETECTED IN GROUND-WATER (ug/L) FEBRUARY 1995
PROPOSED BORING/WELL LOCATION
DATE
REVISED
Prepared By:
LEGGETTE, BRASHEARS & GRAHAM, INC.
Professional Ground-Water and Environmental Services
Northpark Corporate Center
1210 W. County Road E, Suite 700
St. Paul, MN 55112
(612) 490-1405
DAYTON THERMAL PRODUCTS PLANT
DAYTON, OHIO
SOIL & GROUND-WATER QUALITY ALONG CROSS-SECTION B-B'
TRICHLOROETHENE
FILE: 3CHDA02E.DWG
DATE: JULY 1997
FIGURE: 6



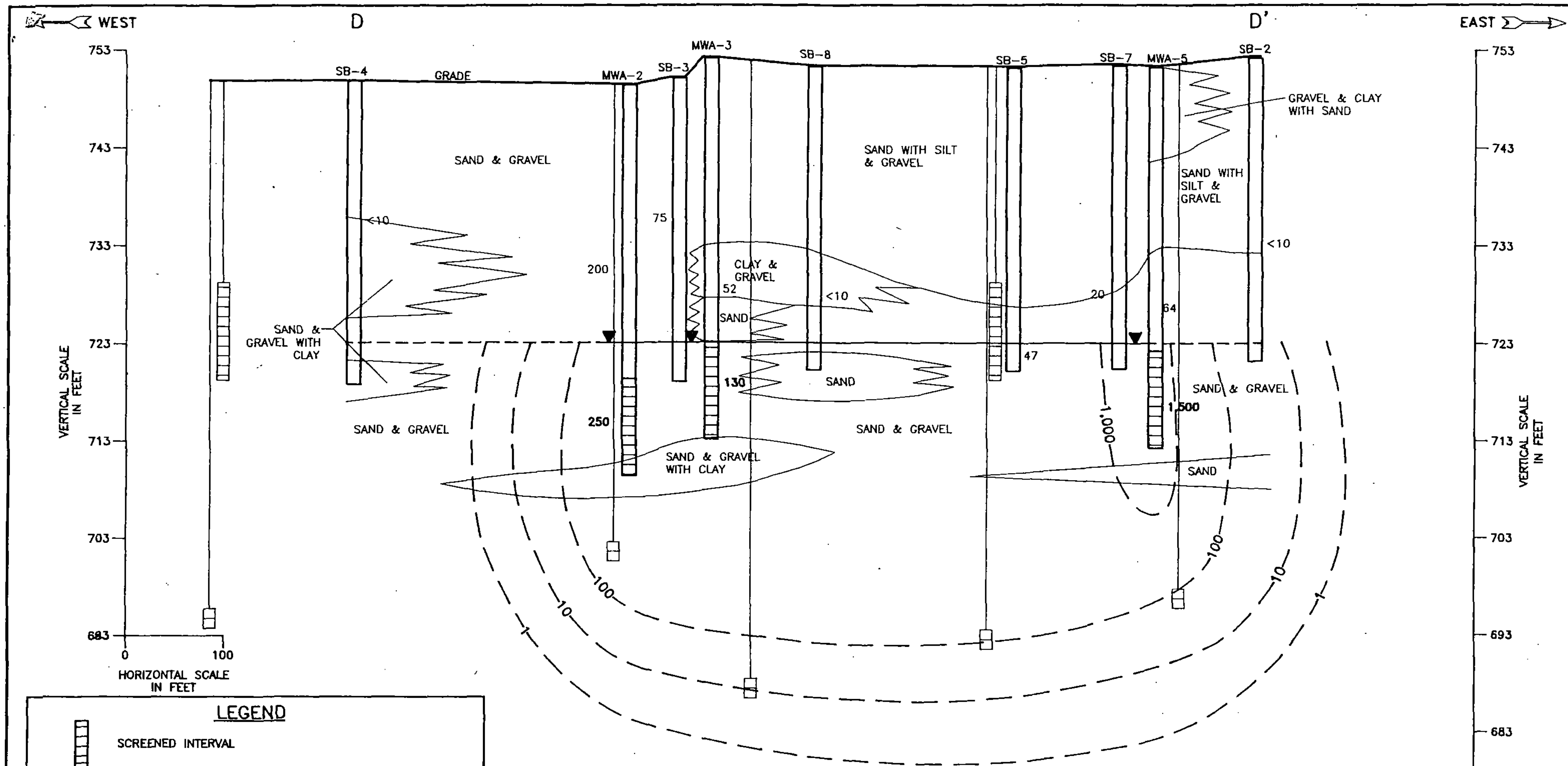
DATE	REVISED

Prepared By:
LEGGETTE, BRASHEARS & GRAHAM, INC.
Professional Ground-Water and Environmental Services
Northpark Corporate Center
1210 W. County Road E, Suite 700
St. Paul, MN 55112
(612) 490-1405

DAYTON THERMAL PRODUCTS PLANT
DAYTON, OHIO

SOIL & GROUND-WATER QUALITY ALONG CROSS-SECTION C-C'
TRICHLOROETHENE

FILE: 3CHDA02E.DWG | DATE: JULY 1997 | FIGURE: 7



LEGEND

SCREENED INTERVAL

EXTENT OF SOIL BORING (PLUGGED BACK TO SCREEN DEPTH)

WATER TABLE ELEVATION (2/20/95)

20 TRICHLOROETHENE DETECTED IN SOIL (ug/KG) OCTOBER/NOVEMBER 1994

1,500 TRICHLOROETHENE DETECTED IN GROUND-WATER (ug/L) FEBRUARY 1995

PROPOSED BORING/WELL LOCATION

DATE	REVISED

Prepared By:
LEGGETTE, BRASHEARS & GRAHAM, INC.
Professional Ground-Water and Environmental Services
Northpark Corporate Center
1210 W. County Road E, Suite 700
St. Paul, MN 55112
(612) 490-1405

DAYTON THERMAL PRODUCTS PLANT
DAYTON, OHIO

SOIL & GROUND-WATER QUALITY ALONG CROSS-SECTION D-D'
TRICHLOROETHENE

FILE: 3CHDA02E.DWG	DATE: JULY 1997	FIGURE: 8

SOIL-VAPOR EXTRACTION/AIR SPARGING
PILOT TEST WORK PLAN
CHRYSLER CORPORATION
DAYTON THERMAL PRODUCTS PLANT
DAYTON, OHIO

Prepared For

Chrysler Corporation

February 1998

LEGGETTE, BRASHEARS & GRAHAM, INC.
Professional Ground-Water and Environmental Engineering Services
1210 West County Road E, Suite 700
St. Paul, Minnesota 55112

TABLE OF CONTENTS

TABLE OF CONTENTS
(continued)

LIST OF TABLES
(at end of report)

LIST OF FIGURES
(at end of report)

SOIL-VAPOR EXTRACTION/AIR SPARGING
PILOT TEST WORK PLAN
CHRYSLER CORPORATION
DAYTON THERMAL PRODUCTS PLANT
DAYTON, OHIO

1.0 INTRODUCTION

Leggette, Brashears & Graham, Inc. (LBG) was retained by Chrysler Corporation (Chrysler) to prepare this work plan detailing the proposed procedures for conducting a soil-vapor extraction (SVE)/air sparging (AS) pilot test at their Dayton Thermal Products Plant (DTPP) located in Dayton, Ohio. The SVE/AS pilot test is being used to determine the effectiveness of these technologies in remediating the source-area unsaturated soils and ground water that have been impacted by chlorinated solvents, including 1,1-dichloroethane, 1,1-dichloroethene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, trichloroethene, tetrachloroethane, 1,2-dichlorobenzene, cis-1,2,-dichloroethene, and methyl ethyl ketone.

The proposed scope of work includes the installation of pilot-test wells and monitoring points, sampling and analyses of soil, ground water and air, and SVE/AS pilot testing. The pilot test is divided up into two test sections, the SVE test and the AS test. The SVE test is expected to take 6 to 8 hours and the AS test will occur over a 2-day period.

The work will be conducted in accordance with applicable state and federal regulations as established by the Ohio Environmental Protection Agency.

2.0 PROJECT OBJECTIVES

The objectives of this work are:

- Confirm the technical feasibility of SVE/AS as remediation alternatives for the unsaturated soil and ground water of the source area.

- Gather the necessary data to design a full-scale remediation system, i.e., the radius of influence of SVE and AS wells and optimum operating parameters.

- Estimate the time frame over which a remediation system must operate to achieve source-area closure.

3.0 SITE BACKGROUND

3.1 Site Location

The site is located at 1600 Webster Street, Dayton, Montgomery County, Ohio (figure 1). The property is approximately 60 acres in size and contains over 1.3 million square feet of building space (figure 2). The site is a manufacturing facility located in a mixed industrial/residential area.

3.2 Site Topography and Hydrology

The elevation of the site is approximately 750 feet above mean sea level. The Dayton area is located in the central lowland physiographic province, which is primarily drained by the Great Miami River and its tributaries (USGS, 1959). The DTPP is located on a flat topped terrace which is an erosional remnant from the outwash of the Mad River. The terrace is bordered on the north, west, and south by flood plains of the Miami and Mad Rivers. The site is located approximately 1,500 feet southeast of the southerly flowing Great Miami River and approximately 4,500 feet northwest of the southwesterly flowing Mad River. The Mad River converges into the Great Miami River approximately 5,000 feet south of the site.

3.3 Site Summary and Conditions

The property was first developed as a manufacturing plant in approximately 1907. Maxwell cars were assembled at the facility. Chrysler purchased the property in 1936. Activities conducted at the plant have included light machining, plating, metal stamping, welding, soldering, degreasing, painting, plastic molding, and assembly and packaging. Some of the products produced at the facility included furnaces, air conditioners, cars, aluminum and copper tubing, fire products, gun parts, bomb shackles, and plastic molding.

Currently, operations at the facility include the manufacture, assembly, and finishing of heat exchangers and air-conditioning components for motor vehicles. The facility consists of eight manufacturing buildings, a powerhouse, wastewater treatment plant, and associated storage buildings (Clean Tech, 1995).

During demolition and construction activities in 1990, an oily material was observed seeping from the east foundation of Building 40B. Additionally, impacted soils were noted beneath concrete slabs, sewer lines, process pipelines and sumps, waste storage pad, oil/water separator, TCA tank and other areas including the footprint of Building 59. Soil samples collected during the demolition and construction indicated the presence of volatile organic compounds (VOCs) and total petroleum hydrocarbons (TPH). Compounds detected have included 1,1- dichloroethane, 1,1-dichloroethene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, trichloroethene, tetrachloroethane, 1,2-dichlorobenzene, cis-1,2,-dichloroethene, and methyl ethyl ketone.

3.4 Site Geology

The DTPP site geology consists primarily of sand and gravel with minor amounts of silt and clay. These are the glacial and glacial-fluvial sediments typical of the region. The sand and gravel is interbedded with till and clay layers composed of massive clay units, or zones of clay with sand and gravel. The uppermost 2 to 4 feet is typically a disturbed clay-bearing material which is absent in many places, probably due to site development activities. None of the previously advanced borings or wells reached the bedrock surface. The predominant geologic unit at the site is a sand and gravel outwash deposit approximately 75 to 90 feet thick. The water table is present in this deposit at a depth of approximately 25 feet below grade level (bgl). Clay units, and units composed of clay, sand and gravel mixtures were encountered within the unconfined aquifer. Several of these units are laterally persistent suggesting they might exert some local control over potential contaminant migration pathways. Beneath the outwash deposit, a persistent till layer was encountered. The till layer has a low permeability, and forms the confining layer between the unconfined outwash aquifer and the underlying semi-confined aquifer. The thickness of the till ranged from 15 to 25 feet thick.

4.0 SCOPE OF WORK

In order to meet the project objectives, the following tasks will be conducted:

- Installation of additional wells and monitoring points to facilitate pilot-test data collection;
- properly dispose of wastes generated from drilling activities;
- sample soil and ground water for compounds of concern;
- conduct SVE/AS pilot-test; and
- collect SVE/AS pilot-test data from select wells, including air samples from the SVE well, to obtain design information required for full-scale system design.

4.1 Health and Safety Plan

A site-specific health and safety plan (HASP) will be prepared by LBG. The HASP will be on site during all site activities. This plan will detail health and safety issues associated with the planned activities. It is anticipated that all work will take place in Level D protection. The safety plan will be distributed to and reviewed by all field personnel prior to initiation of field work.

4.2 Utilities Mapping

Prior to conducting proposed drilling activities, site maps identifying and marking any underground utilities will be acquired, if available. LBG will attempt to locate information pertaining to identification and location of all underground utilities in those areas actively being remediated during these activities. Prior to initiating field activities, LBG will contact DTPP personnel to acquire available utility maps for the facility. If adequate documentation identifying the location of underground utilities cannot be produced by Chrysler, a private utility locating firm will be contracted to locate and identify on-site utilities.

4.3 Well Installation

Several wells and monitoring points will be installed to conduct the SVE/AS pilot tests. All wells will be constructed of 2-inch diameter, schedule 40 polyvinyl chloride (PVC), and completed as flush mount. Figure 3 indicates the SVE/AS pilot test location.

Performance of the SVE test will require the installation of one nested SVE well and seven vapor monitoring points (VMPs) in the unsaturated zone. The proposed construction for the nested SVE well is presented in figure 4. The VMPs will be installed at the depths and spacings shown in figure 5.

The AS test requires the installation of one AS well (figure 6), and five nested air sparging monitor points (ASMPs) in the saturated zone (figure 5). Figure 7 shows a plan view of the proposed locations of pilot-test wells relative to the source area and one another.

The VMPs will be installed by a hollow-stem auger drill rig (figure 8). They will be used to measure the vacuum distribution propagated in the unsaturated zone by the SVE well. Each VMP consists of a short steel screen that is driven into the subsurface and connected to flexible tubing that extends to the ground surface where vacuum measurements can be taken.

The ASMPs will also be installed with a hollow-stem auger drill rig and used to measure the saturated zone pressure that results from the operation of an AS pilot-test blower. The ASMPs will be similar in installation and construction to the VMPs, but are completed below the water table and will vary in depth and distance from the AS well in order to characterize the flow of air in the saturated zone. ASMPs will be installed in five separate locations (figure 7). Three locations will consist of a nest of three ASMPs, and the two locations nearest the AS well will consist of a nest of four ASMPs placed at depths and distances that will cover the portion of the saturated zone expected to contain two-phase (air/water) flow when sparging operations commence (figure 5).

4.4 Drilling and Soil Screening Methodology

A hollow-stem auger drilling rig equipped with a split-spoon sampler will be utilized in the well installation program. For the AS well, split-spoon samples will be collected continuously starting at 1 foot bgl until termination of the boring. All split-spoon samples will be geologically logged in order to determine if low permeability soil layers (that will influence saturated zone air flow) exist in the pilot testing areas. Immediately after the split-spoon sample has been collected and logged, one half of the spoon sediments will be placed in a Mason-type jar, fitted with an aluminum foil seal, agitated, and set aside to equilibrate. If the temperature is below 40 degrees F, the sample will be placed in a warm vehicle and allowed to equilibrate for approximately 10 minutes. The sample will then be agitated once more, and the headspace screened with a photoionization detector (PID) to obtain relative concentrations of VOCs. The sample exhibiting the highest PID reading from select borings will be submitted for laboratory analysis to determine the concentrations of chlorinated VOCs.

One 3-inch diameter, 2-foot long split-spoon sample (the split-spoon sampler will be fitted with a brass sleeve) will be collected from the smear zone in the nested SVE well boring. A 6-inch sleeve of the split-spoon sample from the SVE well will be submitted to a soil engineering testing laboratory to determine the physical properties of the soil. These properties include moisture content, dry soil density, porosity and particle-size analysis. A 6-inch sleeve from this same location will be submitted to Daniel B. Stephens & Associates, Inc. of Albuquerque, New Mexico for analysis to determine the soil moisture retention curve at pressures that occur during typical AS operations.

4.5 Soil-Vapor Extraction Pilot Testing

The SVE pilot tests will include two separate phases. The first phase is a Geologic Formation Curve Test and the second consists of a Variable-Rate Test. The procedures for these two tests are described below and the equipment that will be used to conduct the test is presented in figure 9.

4.5.1 Geologic Formation Curve Test

The Geologic Formation Curve Test will be the first phase of SVE testing conducted. This short test (typically less than ½-hour duration) is conducted to create a curve that describes the ability of a geologic formation to transmit air. This test is performed by incrementally increasing the wellhead vacuum placed on the extraction well, starting with a low vacuum and increasing to a high vacuum. An initial vacuum of 5 inches of water (or minimum achievable) will be placed on the extraction well, and the wellhead vacuum and the corresponding flow rate will be recorded. The wellhead vacuum will be increased in 1 to 5 inches of water increments (depending on the permeability of the sediments) until the pilot-test blower becomes limited by flow or vacuum. The various wellhead vacuums and resulting SVE well-flow rates are recorded and plotted on an x-y graph. This information is used to determine the capacity of the sediments surrounding an SVE well to transmit soil vapor and to determine the point at which flow deviates from Darcy's Law. At the conclusion of the Geologic Formation Curve Test, the pilot-test blower is deactivated and the subsurface is allowed to return to pre-test pressure conditions. The top portion of table 1 details the parameters measured during the Geologic Formation Curve Test and the time these parameters are measured relative to test start up.

4.5.2 Variable-Rate Test

The Variable-Rate Test will follow the Geologic Formation Curve Test. The test is initiated once the subsurface pressure conditions have returned to pre-test conditions. The Variable-Rate Test will utilize four wellhead vacuums and corresponding flow rates. Each step will last approximately 1 hour. The first step of the Variable-Rate Test begins with a wellhead vacuum that is 25 percent of the maximum wellhead vacuum achieved during the Geologic Formation Curve Test. The vacuum propagated in the subsurface is measured in the VMPs. A full round of operating and response parameter readings is measured during this initial step of the test and again before the second step of 50 percent of the maximum wellhead vacuum is initiated. The third and fourth steps, each operating at 75 and 100 percent of the maximum wellhead vacuum, are also conducted with operating and response parameters measured before, during, and after each step.

The parameters that will be measured during the Variable-Rate Test are described in detail in the bottom portion of table 1.

4.5.3 SVE Data Analysis and Interpretation

The following sections discuss the design parameters that will be developed from the data obtained during the SVE pilot test. The subsurface vacuum data will be analyzed to determine the observed radius of influence (ROI) at various flow rates and wellhead vacuums. Graphs showing the relationship of SVE well flow rate to the wellhead vacuum and the observed ROI will be prepared. The information presented in these graphs will be combined with the results of the physical and chemical soil sampling to determine the effective ROI of the SVE well.

4.5.3.1 Pneumatic Permeability

The pneumatic permeability of the unsaturated soils will be determined using the flow rate, wellhead vacuum and subsurface vacuum data measured in the field. These parameters are used as input in a numerical model that uses the inverse method to determine both horizontal and vertical pneumatic permeability values (Falta, 1996).

4.5.3.2 Observed Radius of Influence

The observed ROI, defined as the distance at which the subsurface vacuum distribution equals atmospheric pressure, will be determined from plots of LOG vacuum versus distance from the extraction well. These plots are important input into the computer models used to determine the effective ROI of a SVE well.

4.5.3.3 Effective Radius of Influence and Remediation Time Estimate

The effective ROI is defined as the maximum horizontal distance from an extraction well through which sufficient air can be drawn to remediate contaminated soil to a required concentration in an acceptable period of time. The physical and chemical soil properties, along with pilot-test data, will be used as input parameters to two numerical models (Wilson, Clarke and Clarke, 1988). These models will be used to calculate the effective ROI of full-scale SVE wells. The final model calculates transient two-dimensional contaminant mass removal that can be utilized to determine the effective ROI of a SVE well given a specific air-flow rate, duration of remediation and soil clean-up criteria.

4.6 Air Sparging Pilot Testing

The following discussion provides background information and a detailed description of the technical approach that will be employed to design, conduct and evaluate the AS pilot test. The equipment that will be utilized to conduct the AS pilot test is presented in figure 10. The equipment used during the SVE pilot test (figure 9) will be operated concurrently with the AS equipment for the duration of active AS testing activities.

4.6.1 AS Pilot Test Procedure Description

The AS pilot test will consist of three test phases, an AS Well Performance-Curve test, an AS Step Test (transient conditions) and an AS Constant-Rate Test (steady-state conditions).

4.6.1.1 AS Well Performance-Curve Test

The AS Well Performance-Curve Test is used to gather the data necessary to prepare a plot that describes the ability of an aquifer to accept air at a given wellhead pressure. The testing procedure involves incrementally increasing and decreasing the wellhead pressure on an AS well, while recording the pressure and the resulting air flow rate. The test will continue until the pilot-test compressor becomes limited by flow or pressure. Operational parameters measured during the AS Well Performance-Curve Test are summarized in the top portion of table 2.

4.6.1.2 AS Step Test

The AS Step Test is used to determine the ROI of an AS well at various wellhead pressures under transient conditions. The AS Step Test will utilize three to four wellhead pressures and corresponding injection flow rates. Each step will last approximately 1.5 hours. The response parameters will be measured in the ASMPs a minimum of two times at each valve setting during this phase of testing. This test is conducted under transient conditions because many full-scale systems cycle AS wells in order to take advantage of the higher air saturation levels and greater ROI that occur during transient conditions. Operational and response parameters measured during the AS Step Test are summarized in the bottom portion of table 2.

4.6.1.3 AS Constant-Rate Test

The AS Constant-Rate Test will begin immediately following the last round of AS Step Test data collection. The Constant-Rate Test utilizes the highest injection flow rate attained during the AS Step Test (usually less than 50 standard cubic feet per minute [scfm]). This phase of testing will begin near the end of a work day, and the SVE/AS equipment will be operated overnight. This length of time should last at least 12 hours, during which steady-state flow conditions should be reached. The data collected at the end of this constant flow rate operation period can be used to determine an effective ROI for an AS well based on saturated-zone air saturation values (McCray and Falta, 1996). The bottom of table 2 summarizes operational and response parameters monitored during the AS Constant-Rate Test.

4.6.2 AS Data Analysis and Interpretation

The ROI of an AS well, along with the wellhead pressure and the corresponding AS well flow rate are the primary full-scale system design parameters that must be determined through pilot testing. The AS wellhead pressure and flow rate can be directly measured during the pilot test. The AS observed ROI is determined by saturated-zone pressure measurements using transient and/or steady-state data. The effective ROI is determined by comparing steady-state saturated-zone pressure measurements and a laboratory determined soil moisture retention curve. The following sections describe the methods that will be utilized used to quantify this key parameter under both transient and steady-state conditions.

4.6.2.1 Transient Data

Saturated-zone pressure versus distance is the primary method that will be used to estimate the observed ROI under transient conditions. The observed AS ROI is defined as the maximum horizontal distance from the AS well that injected air passes through the base of the smear zone. An increase in saturated-zone pressure measured in the ASMPs are a direct indication of saturated-zone air flow in the vicinity of the ASMP screen. This saturated-zone pressure data can be further evaluated if the sparged aquifer has reached steady-state conditions. The following section discusses this phenomenon in more detail.

4.6.2.2 Steady-State Data

The effective ROI of an AS well is defined as the maximum horizontal distance from the AS well through which sufficient air can be injected to remediate saturated soil and ground water in a reasonable amount of time. The AS well's effective ROI will be estimated according to saturated zone pressure in conjunction with a site-specific soil moisture retention curve, which is determined from laboratory testing. The soil moisture retention curve can be used to determine in-situ, saturated-zone, air saturation levels using the pressures measured in the ASMPs during steady-state AS pilot testing. Under steady-state, multi-phase flow conditions, the pressure measured in the ASMPs is related to the air-water capillary pressure. The hydrostatic pressure exerted on an ASMP can be subtracted from saturated-zone pressure measured in the ASMPs, resulting in a capillary pressure. This capillary pressure correlates directly with a unique air saturation, which can be determined through the use of the soil moisture retention curve.

An acceptable air saturation value for remediation of dissolved-phase volatile hydrocarbons is 5 to 10 percent. The maximum horizontal distance from the AS well having an air saturation of 5 to 10 percent is the effective ROI of an AS well for dissolved volatile compounds. This value is more conservative than those based on data collected under transient conditions and ensures acceptable remediation time frames due to the presence of sufficient saturated zone air flow.

4.7 Air Emissions

Two air samples will be collected from the pilot tests and submitted for laboratory analysis to determine the concentrations of chlorinated VOCs in off-gas. The first sample is collected at the end of the SVE pilot test to estimate the maximum SVE emission rate. The second sample will be collected from the SVE off-gas at the end of the AS test to evaluate the effectiveness of the AS technology. The results of each air emission sampling event will be used to estimate the maximum emissions generated by a full-scale SVE/AS system. This information will then be evaluated with regard to state regulations regarding emissions of VOCs. Table 3 presents a summary of all of the samples that will be collected during pilot testing activities and the methods used to analyze them.

4.8 Waste Disposal

It is anticipated that soil cuttings from drilling operations will be disposed off site as a non-hazardous solid waste. Waste classification samples, as may be required by disposal facilities, will be collected by LBG if necessary.

5.0 REPORTING

An evaluation report will be prepared upon receipt of the analytical results of the soil and air samples. The report will include an overview of drilling, sampling, testing, and other related activities which occurred during the field work.

The data collected from the pilot tests will be reviewed and summarized from an engineering perspective, and will be presented by tables and graphs. Also included will be a discussion of the results of the SVE/AS pilot tests, estimates of the SVE/AS wells' effective ROI, and a discussion of the evaluation methods. Detailed boring logs, well-construction diagrams, field sampling logs, laboratory analytical reports, and chain-of-custody reports will be included as appendices.

Recommendations for future site activities, combined with an evaluation of the feasibility of implementing SVE/AS technology, will be presented in the report. A discussion of the need for off-gas control will also be included.

LEGGETTE, BRASHEARS & GRAHAM, INC.

Matthew P. Peramaki (KB)

Matthew P. Peramaki, P.E.
Associate

Kimberly Blomker

Kimberly Blomker
Environmental Engineer II

Reviewed by:

J. Kevin Powers

J. Kevin Powers
Vice President

kw
February 25, 1998
S:\TECH\3CHRY\DAYTON\FINALDOC\SVEWRKPL.WPD

REFERENCES

Clean Tech, Inc., "Site Investigation, Chrysler Corporation Dayton Thermal Products Plant, Dayton, Ohio," September 1995.

Falta, R.W. 1996. "A Program for Analyzing Transient and Steady-State Soil Gas Pump Tests." *Groundwater*; Vol. 34, No.4. July-August, 1996. Pp. 750-755.

McCray, J.E., and R.W. Falta. 1996. "Defining the Air Sparging Radius of Influence for Ground-Water Remediation." *Journal of Contaminant Hydrology*, 24 (1996). Pp. 25-52.

U. S. Geological Survey, S.E. Norris, "Vertical Leakage Through Till as a Source of Recharge to a Buried-Valley Aquifer at Dayton, Ohio," 1959.

Wilson, D.J., A.N. Clarke, and J.H. Clarke. 1988. "Soil Clean Up by *in-situ* Aeration. I. Mathematical Modeling." *Separation Science and Technology*, 23 (10 & 11) 1988. Pp. 991-1037.

TABLES

TABLE 1
CHRYSLER CORPORATION
DAYTON THERMAL PRODUCTS PLANT
DAYTON, OHIO

SUMMARY OF SOIL-VAPOR EXTRACTION PILOT TEST MONITORING PARAMETERS

Soil-Vapor Extraction Pilot Test																
		Geologic Formation Curve Test														
Parameter	Pre-Test	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5
SVE Wellhead Data:																
Wellhead Vacuum	—	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Flow Rate	—	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Soil-Vapor Extraction Pilot Test																	
		Variable-Rate Test															
		25%				50%				75%				100%			
Parameter	Pre-Test	15	30	45	60	75	90	105	120	135	150	165	180	195	210	225	240
Atmospheric Data:																	
Barometric Pressure	x				x				x				x				x
SVE Wellhead Data: (Operating Parameters)																	
Wellhead Vacuum	—	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Flow Rate	—	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Soil Vapor Concentration	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Oxygen/LEL	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Air Sample Collected	—																x
Vapor Monitoring Point Data: (Response Parameters)																	
Vacuum	x		x		x		x		x		x		x		x		x
Soil Vapor Concentration	x		x		x		x		x		x		x		x		x
Oxygen/LEL	x		x		x		x		x		x		x		x		x

LEL: Lower Explosive Limit

SVE: Soil-vapor extraction

Numbers represent time in minutes from the start of the SVE test.

Percentages represent a fraction of the highest vacuum measurement determined from the Geologic Formation Curve Test.

TABLE 2
CHRYSLER CORPORATION
DAYTON THERMAL PRODUCTS PLANT
DAYTON, OHIO

SUMMARY OF AIR SPARGING PILOT TEST
MONITORING PARAMETERS

Air Sparging Pilot Test																
		Well Performance-Curve Test														
Parameter	Pre-Test	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5
AS Wellhead Data:																
Wellhead Pressure	—	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Flow Rate	—	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Air Sparging/Soil-Vapor Extraction Combination Pilot Test																		
		Step Test (Transient Monitoring)																Constant Rate Test
		Step 1				Step 2				Step 3				Step 4				(Steady State Monitoring)
Parameter	Pre-Test	25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	1440
Atmospheric Data:																		
Barometric Pressure	x				x				x				x				x	x
AS Wellhead Data: (Operating Parameters)																		
Wellhead Pressure	—	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Flow Rate	—	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
SVE Wellhead Data: (Operating Parameters)																		
Wellhead Vacuum	—		x		x		x		x		x		x		x		x	x
Flow Rate	—		x		x		x		x		x		x		x		x	x
Soil Vapor Concentration	x		x		x		x		x		x		x		x		x	x
Oxygen/LEL	x		x		x		x		x		x		x		x		x	x
Air Sample Collected	—																	x
Vapor Monitoring Point Data: (Response Parameters)																		
Vacuum/Pressure	x		x		x		x		x		x		x		x		x	x
Soil Vapor Concentration	x		x		x		x		x		x		x		x		x	x
Oxygen/LEL	x		x		x		x		x		x		x		x		x	x
Air Sparging Monitoring Point Data: (Response Parameters)																		
Pressure	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

LEL: Lower Explosive Limit
SVE: Soil-vapor extraction
Numbers represent time in minutes from the start of each individual SVE/AS test.

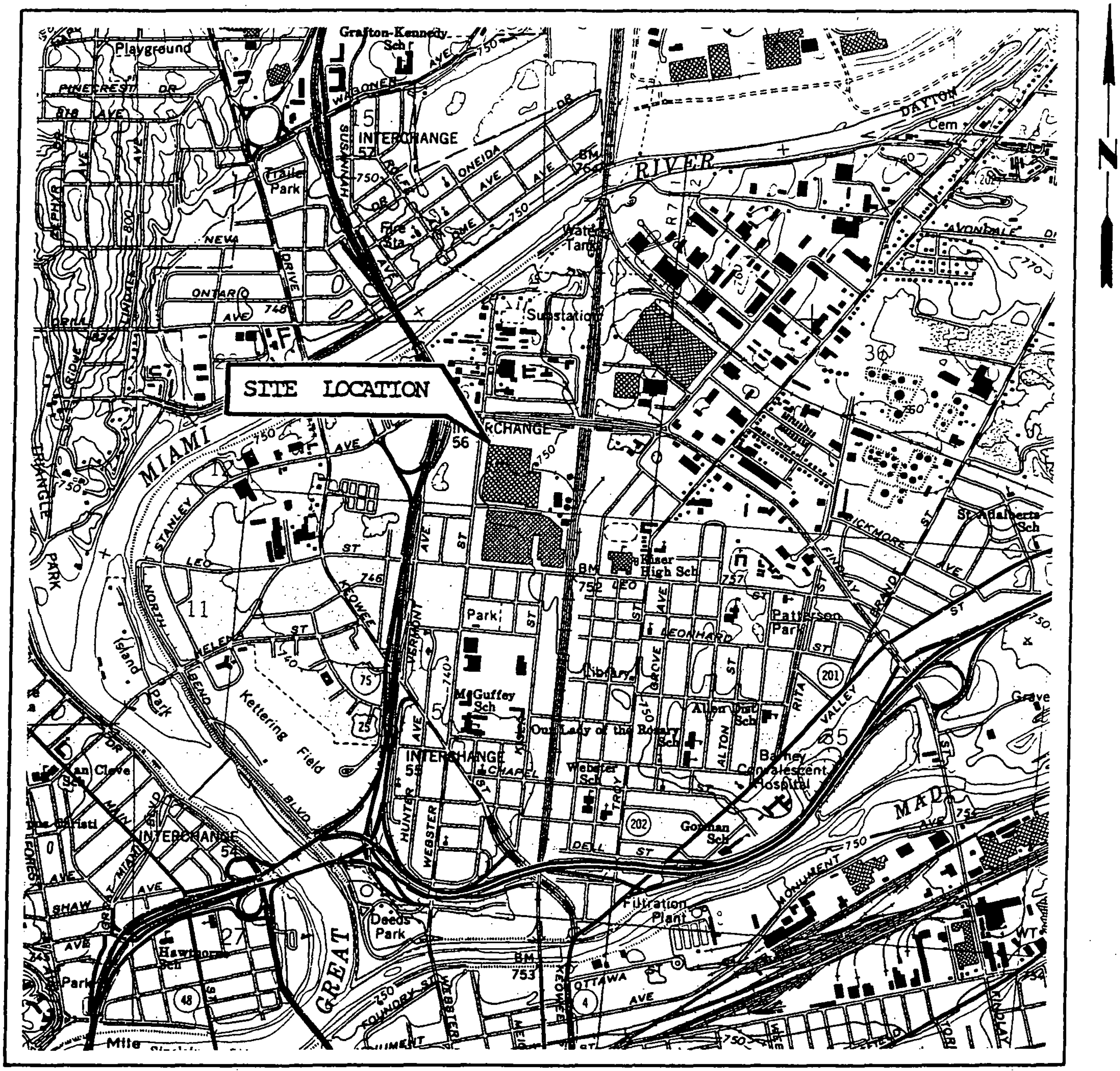
TABLE 3
CHRYSLER CORPORATION
DAYTON THERMAL PRODUCTS PLANT
DAYTON, OHIO

SAMPLE AND ANALYSES TABLE

Type of Sample	Time of Sampling Event			Analytical Methods	Total Number of Samples
	Drilling	SVE Test	AS/SVE Test		
Air Samples		x	x	EPA 18; NIOSH	2
Soil Moisture Retention Curve	x			—	1
Soil Properties: moisture content, grain size, porosity and bulk density	x			—	1
Chlorinated VOCs	x			8260	2

SVE: Soil-Vapor Extraction
AS: Air Sparging
VOCs: Volatile Organic Compounds

FIGURES



0 2000

SCALE IN FEET

QUADRANGLE LOCATION

U.S.G.S. TOPOGRAPHIC

DAYTON NORTH, OHIO

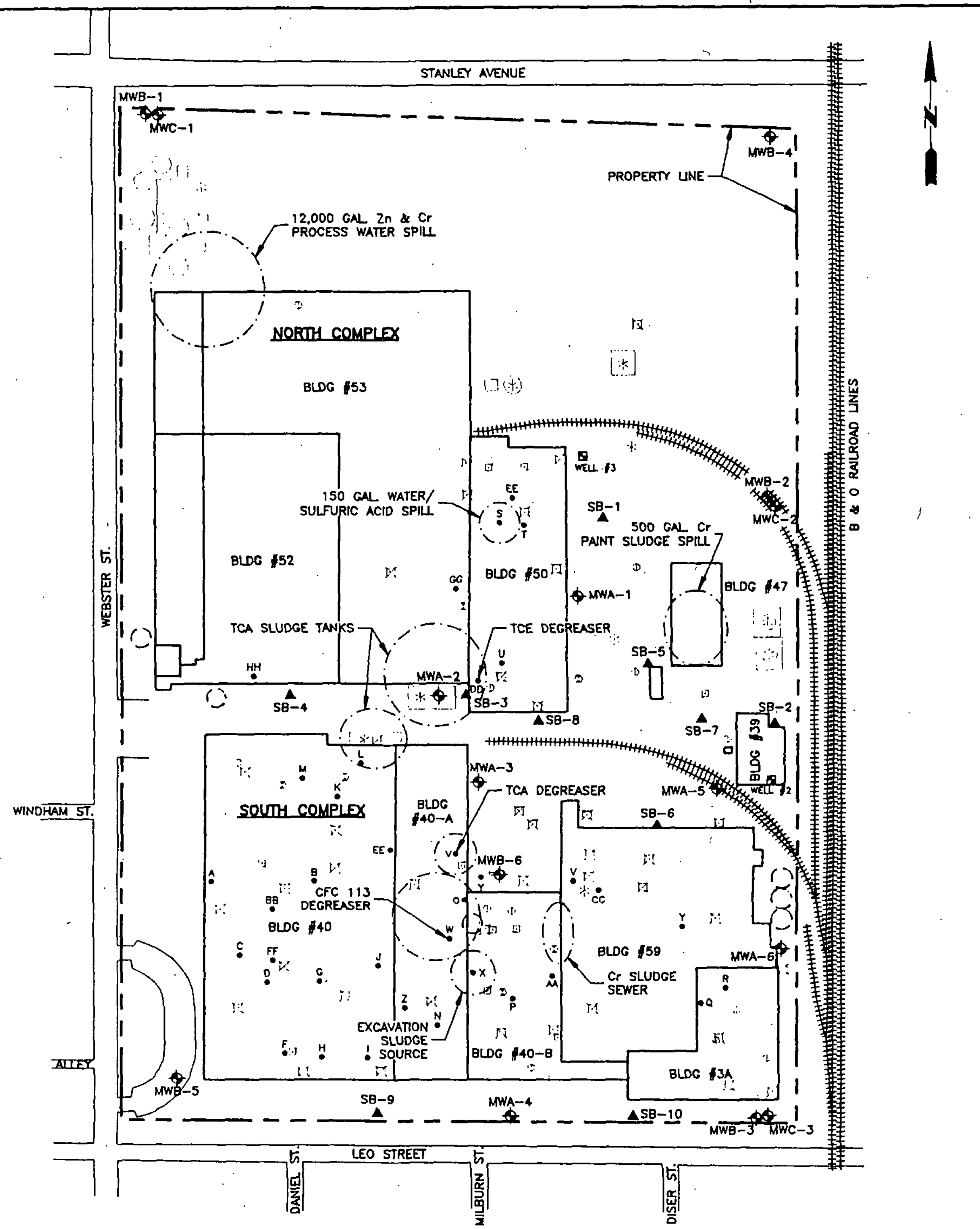
7.5 MINUTE QUADRANGLE

DAYTON THERMAL PRODUCTS PLANT

DAYTON, OHIO

AREA LOCATION MAP

DATE	REVISED	
		PREPARED BY:
		LEGGETTE, BRASHEARS & GRAHAM, INC.
		Professional Ground-Water and Environmental Services
		Northpark Corporate Center
		1210 W. County Road E, Suite 700
		St. Paul, MN 55112
		(612) 490-1405
FILE:		DATE: JULY 1997 FIGURE: 1



LEGEND

- WELL LOCATION
- SOIL BORING LOCATION
- WATER SUPPLY WELL
- PROCESS WASTEWATER SUMP
- WASTE OIL SUMP
- HAZARDOUS WASTE GENERATION OR ACCUMULATION AREA
- UNDERGROUND STORAGE TANK
- ABOVE GROUND STORAGE TANK AREA
- INDUSTRIAL CLEANING SOLUTION TANKS (250-500 GALLON)
- F• PROCESS UNIT & LOCATION
- POSSIBLE SOURCE AREA

SOURCE: CLEAN TECH, INC.

0 200

APPROX. SCALE IN FEET

PROCESS EQUIPMENT DESCRIPTION

A FIRST IMPREGNATION, LOCTITE SYSTEM
B SHAFT ASSEMBLY
C WEST COOLANT PIT
D CARGILL WASHER
E PISTON WASHER
F SOUTH SHELL WASHER
G EAST COOLANT PIT
H SOUTH COOLANT PIT
I SECOND IMPREGNATION, LOCTITE SYSTEM
J NORTH COOLANT PIT
K SHAFT WASHER
L CLUTCH RETAINER WASHER
M STEEL MACHINING COOLANT PIT
N PHOSPHATING WASHER
O CLEANER TANKS
P PAINT BOOTH
Q PAINT BOOTH
R NEW WASHER
S WASHER TANKS
T CLEANER TANKS
U FLUSH WASHER SYSTEM
V MANPRO DEGREASER
W PLATE/FIN EVAPORATOR DEGREASER
X PARTS DEGREASER
Y PLATING OPERATION
Z SWASHPLATE HEAT TREATMENT MACHINE
AA NEW DETRIX DEGREASER
BB COMPRESSOR PARTS DEGREASER
CC DIP TANK
DD DEGREASER
EE DETREX DEGREASER
FF FREON DEGREASER
GG XYLOL-BASED PAINT BOOTH
HH VAPOR DEGREASER

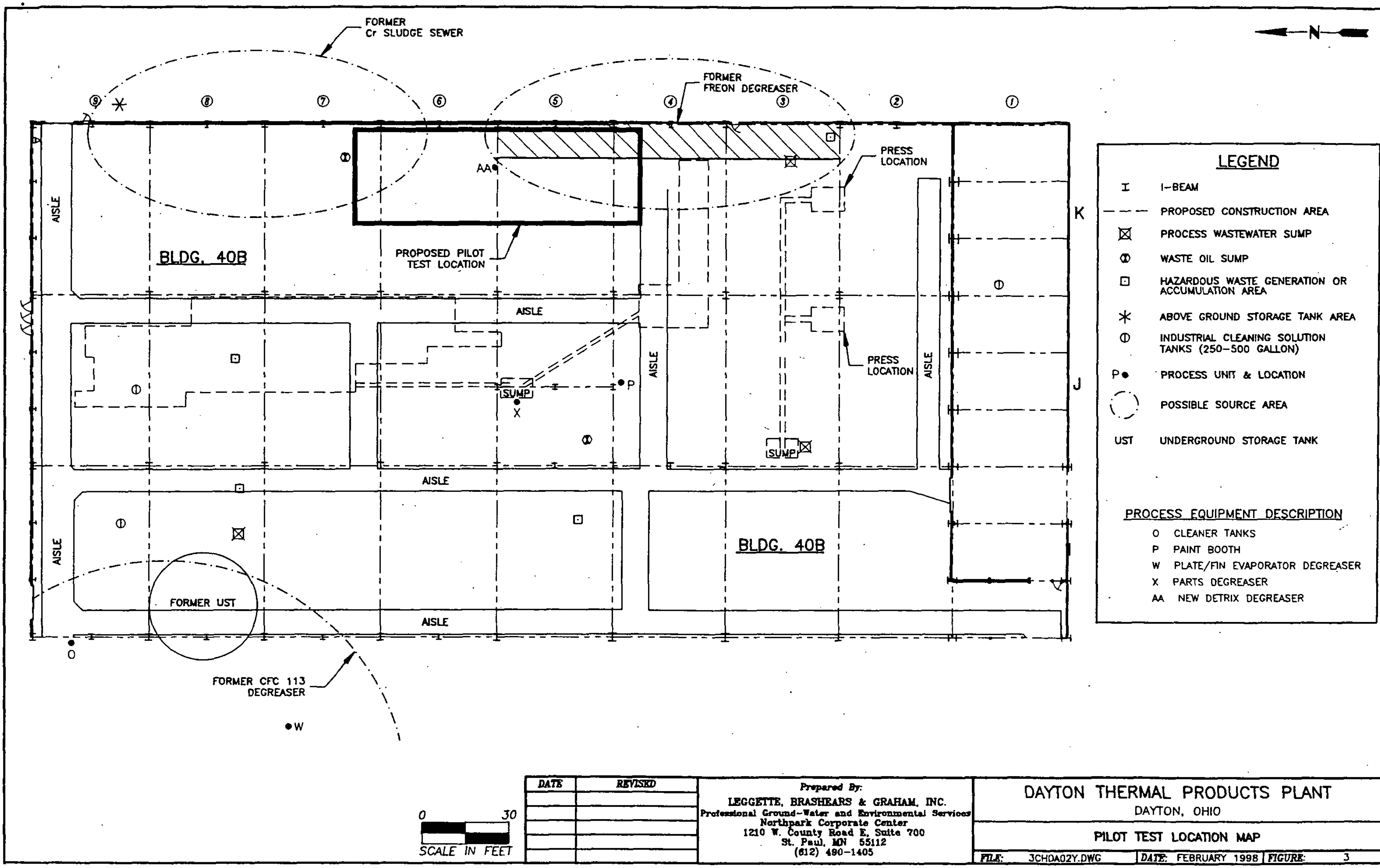
DATE	REVISED

Prepared By:
LEGGETTE, BRASHEARS & GRAHAM, INC.
Professional Ground-Water and Environmental Services
Northpark Corporate Center
1210 W. County Road E, Suite 700
St. Paul, MN 55112
(612) 490-1405

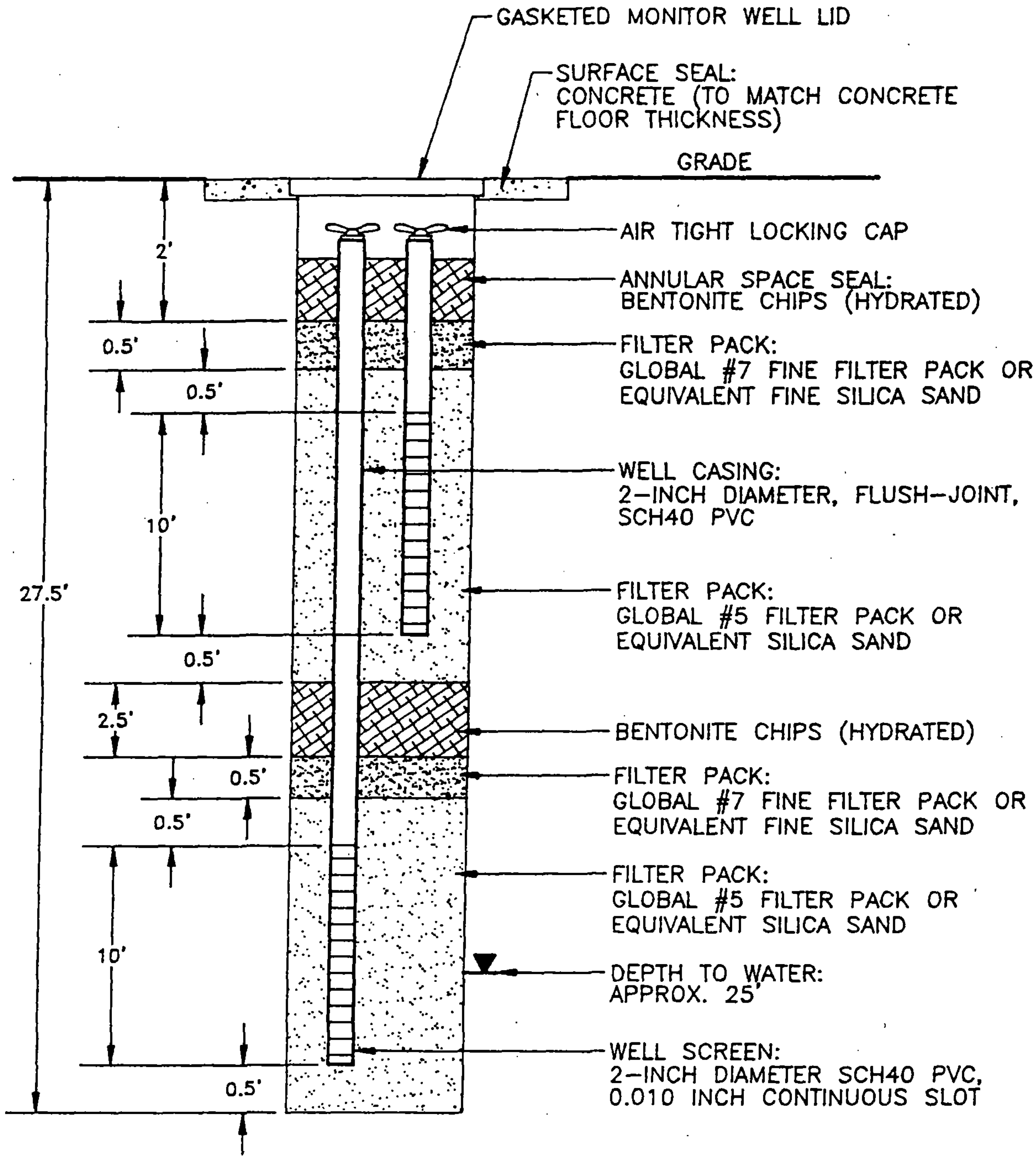
DAYTON THERMAL PRODUCTS PLANT
DAYTON, OHIO

SITE MAP

FILE: 3CHDA021.DWG | DATE: NOV. 1997 | FIGURE: 2

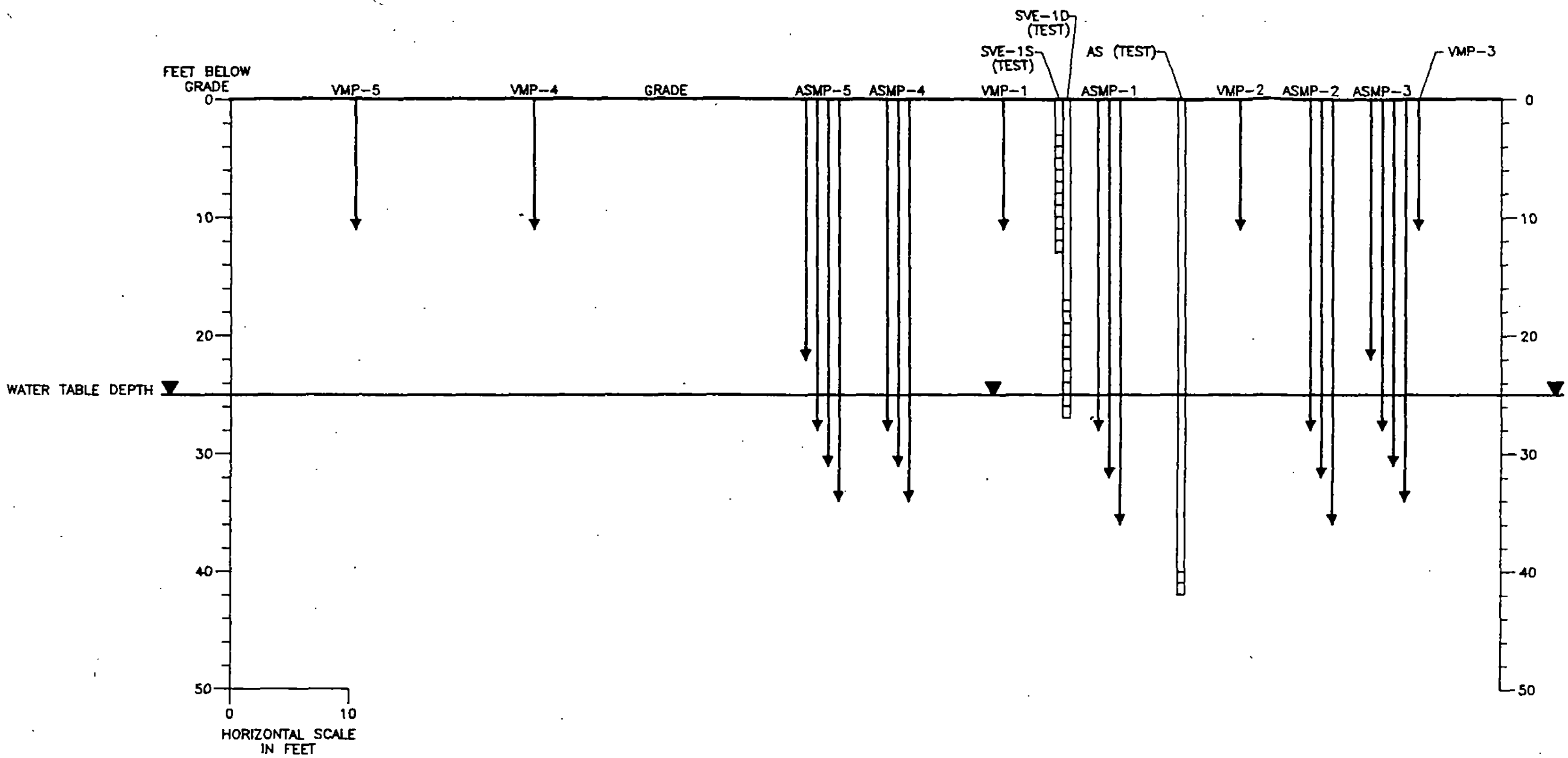


N
FORMER
Cr SLUDGE SEWER
FORMER
FREON DEGREASER
9
8
7
6
5
4
3
2
1
PRESS
LOCATION
AA
AISLE
BLDG. 40B
PROPOSED PILOT
TEST LOCATION
K
AISLE
SUMP
X
P
AISLE
PRESS
LOCATION
AISLE
J
SUMP
AISLE
AISLE
BLDG. 40B
FORMER UST
AISLE
O
FORMER CFC 113
DEGREASER
W
LEGEND
I-BEAM
PROPOSED CONSTRUCTION AREA
PROCESS WASTEWATER SUMP
WASTE OIL SUMP
HAZARDOUS WASTE GENERATION OR ACCUMULATION AREA
ABOVE GROUND STORAGE TANK AREA
INDUSTRIAL CLEANING SOLUTION TANKS (250-500 GALLON)
P PROCESS UNIT & LOCATION
POSSIBLE SOURCE AREA
UST UNDERGROUND STORAGE TANK
PROCESS EQUIPMENT DESCRIPTION
O CLEANER TANKS
P PAINT BOOTH
W PLATE/FIN EVAPORATOR DEGREASER
X PARTS DEGREASER
AA NEW DETRIX DEGREASER
0
30
SCALE IN FEET
DATE
REVISED
Prepared By:
LEGGETTE, BRASHEARS & GRAHAM, INC.
Professional Ground-Water and Environmental Services
Northpark Corporate Center
1210 W. County Road E, Suite 700
St. Paul, MN 55112
(612) 490-1405
DAYTON THERMAL PRODUCTS PLANT
DAYTON, OHIO
PILOT TEST LOCATION MAP
FILE: 3CHOA02Y.DWG
DATE: FEBRUARY 1998
FIGURE: 3



NOT TO SCALE

DAYTON THERMAL PRODUCTS PLANT DAYTON, OHIO		
NESTED SVE WELL CONSTRUCTION DIAGRAM		
DATE	*REVISED*	*PREPARED BY:* LEGGETTE, BRASHEARS & GRAHAM, INC. Professional Ground-Water and Environmental Services Northpark Corporate Center 1210 W. County Road E, Suite 700 St. Paul, MN 55112 (612) 490-1405
FILE:	3CHDA02W.DWG	*DATE:* DECEMBER 1997 *FIGURE:* 4



LEGEND

SCREENED INTERVAL

WATER TABLE

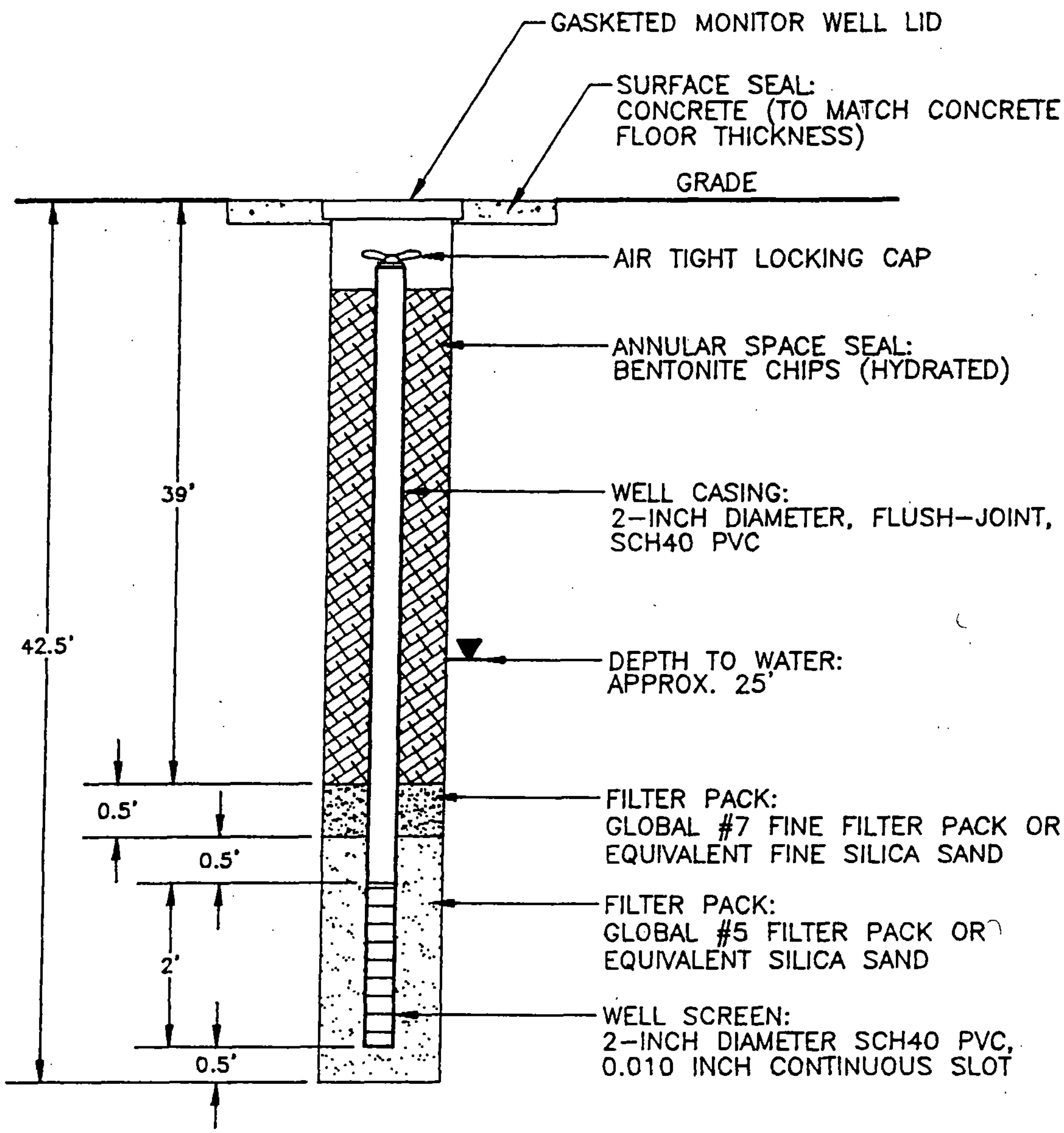
DATE	REVISED

Prepared By:
LEGGETTE, BRASHEARS & GRAHAM, INC.
Professional Ground-Water and Environmental Services
Northpark Corporate Center
1210 W. County Road E, Suite 700
St. Paul, MN 55112
(612) 490-1405

DAYTON THERMAL PRODUCTS PLANT
DAYTON, OHIO

VAPOR & AIR SPARGING MONITORING POINTS

FILE: 3CHDA02Z.DWG | DATE: DECEMBER 1997 | FIGURE: 5



NOT TO SCALE

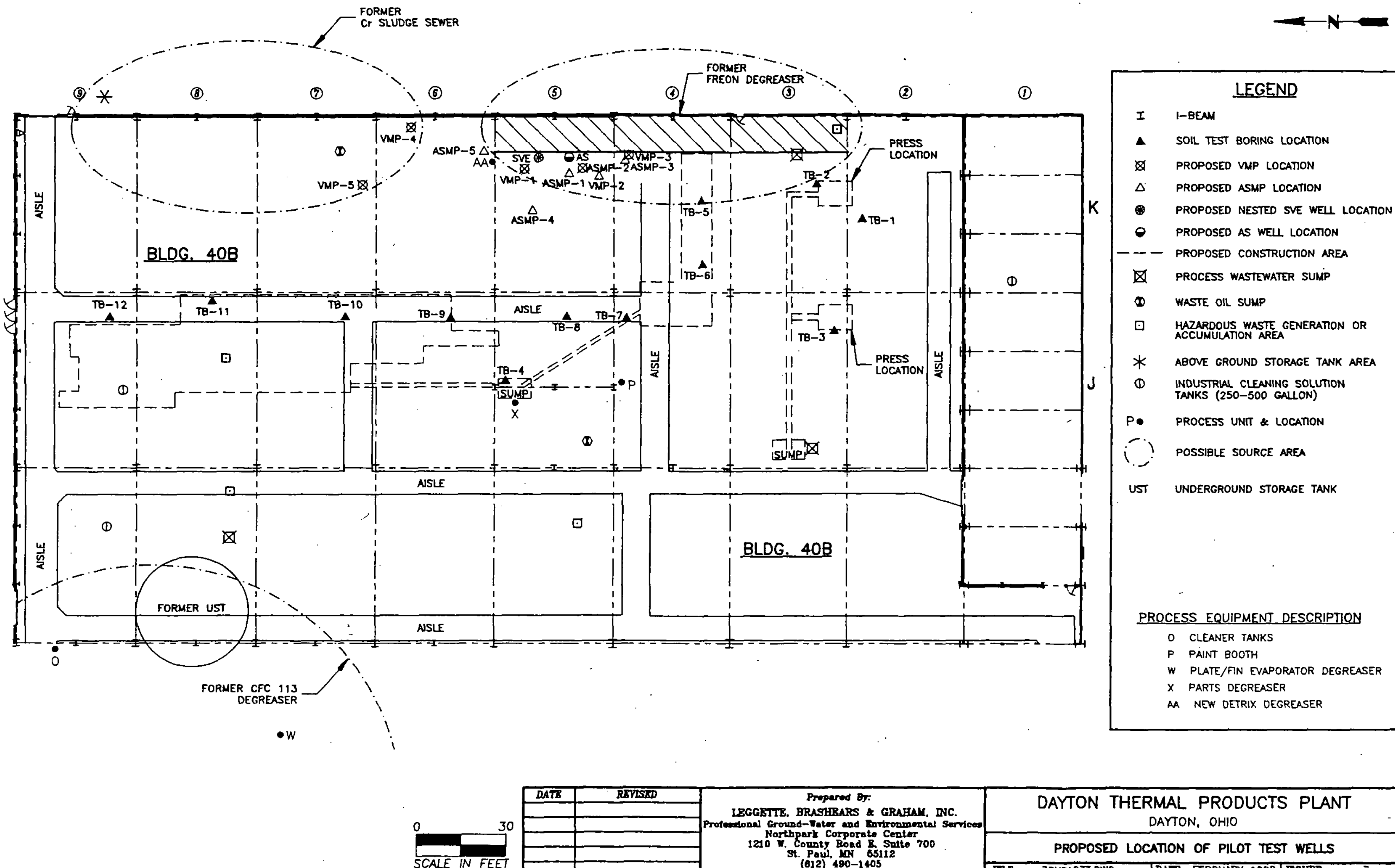
DAYTON THERMAL PRODUCTS PLANT

DAYTON, OHIO

AS WELL CONSTRUCTION DIAGRAM

DATE	REVISED	PREPARED BY:
		LEGGETTE, BRASHEARS & GRAHAM, INC.
		Professional Ground-Water and Environmental Services
		Northpark Corporate Center
		1210 W. County Road E, Suite 700
		St. Paul, MN 55112 (612) 490-1405

FILE: 3CHDA02W.DWG | DATE: DECEMBER 1997 | FIGURE: 6



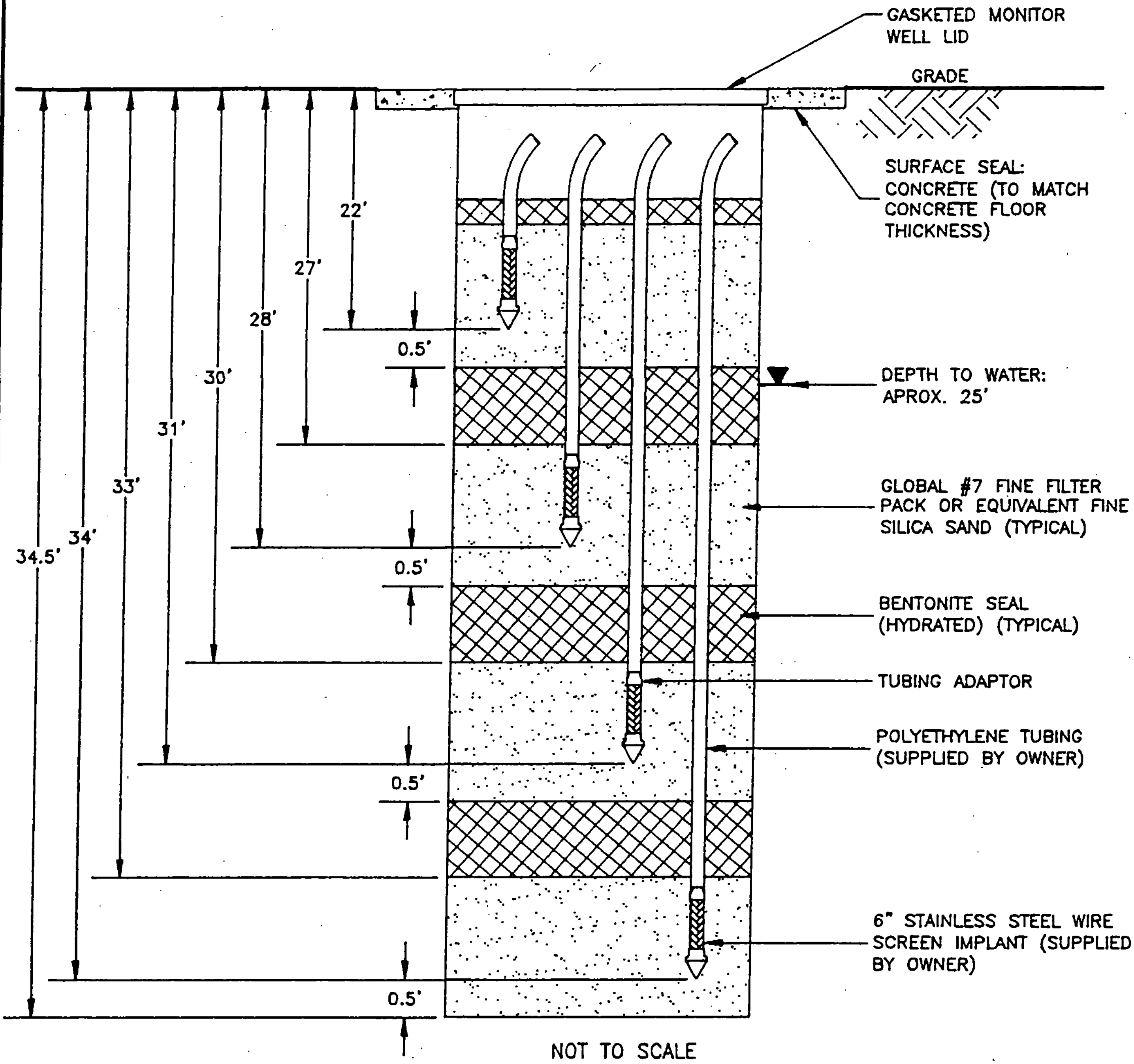
DATE	REVISED

Prepared By:
LEGGETTE, BRASHEARS & GRAHAM, INC.
Professional Ground-Water and Environmental Services
Northpark Corporate Center
1210 W. County Road E, Suite 700
St. Paul, MN 55112
(612) 490-1405

DAYTON THERMAL PRODUCTS PLANT
DAYTON, OHIO

PROPOSED LOCATION OF PILOT TEST WELLS

FILE: 3CHDA03T.DWG | DATE: FEBRUARY 1998 | FIGURE: 7

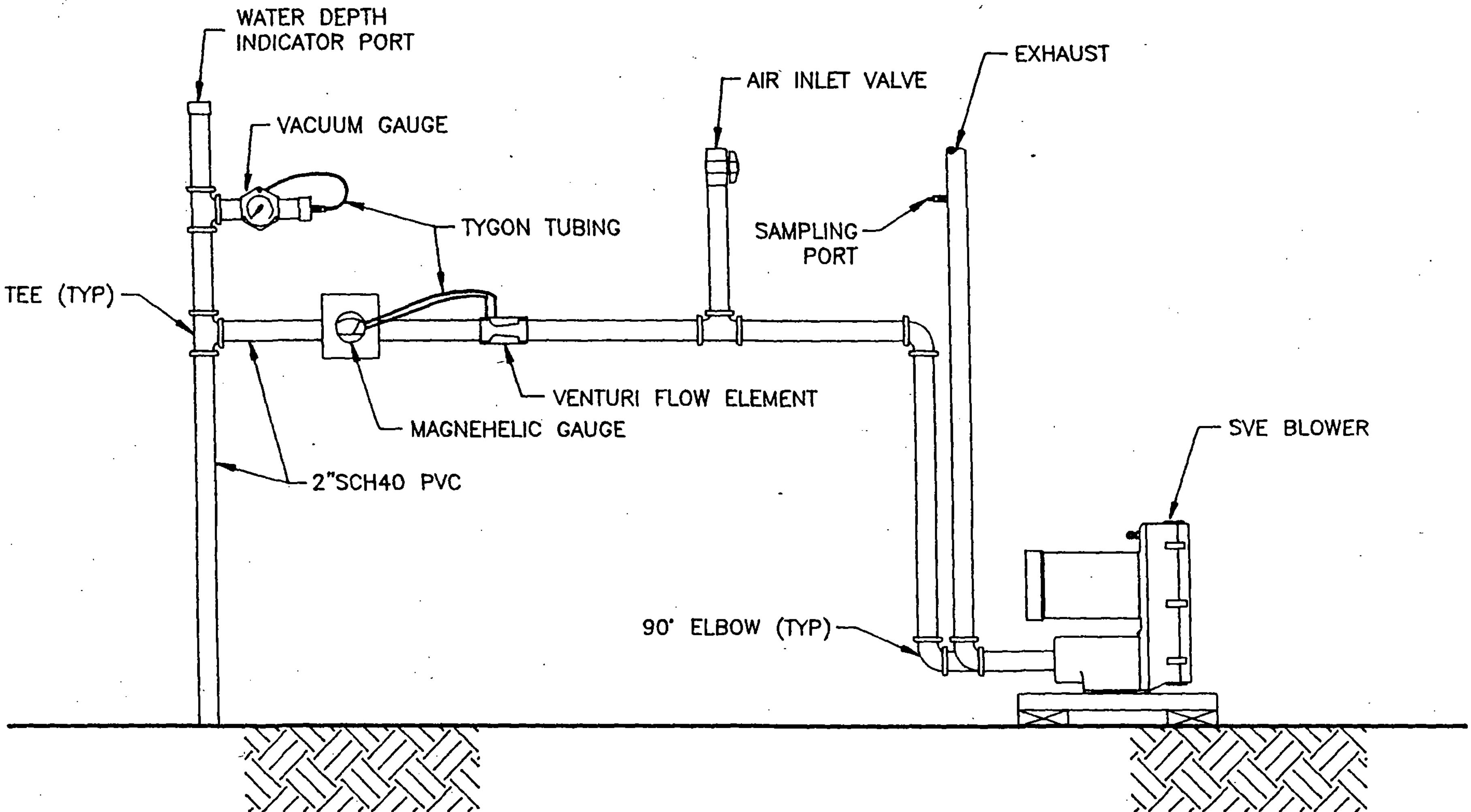


NOT TO SCALE

DAYTON THERMAL PRODUCTS PLANT
DAYTON, OHIO

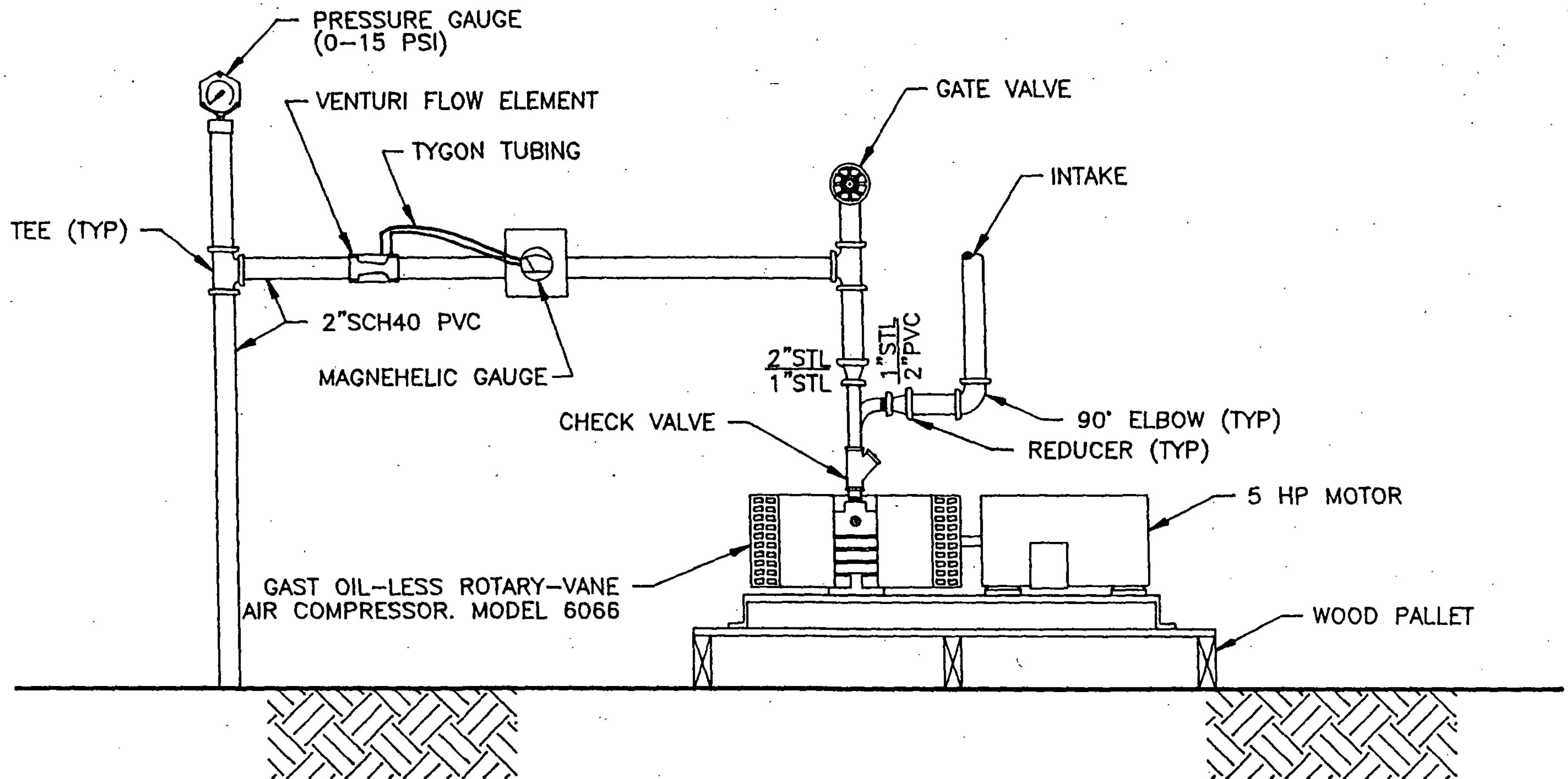
TYPICAL VMP/ASMP INSTALLATION

DATE	REVISED	PREPARED BY:
		LEGGETTE, BRASHEARS & GRAHAM, INC. Professional Ground-Water and Environmental Services Northpark Corporate Center 1210 W. County Road E, Suite 700 St. Paul, MN 55112 (612) 490-1405
FILE:	3CHDA03A.DWG	DATE: DECEMBER 1997 FIGURE: 8



NOT TO SCALE

DATE	REVISED		
		Prepared By: LEGGETTE, BRASHEARS & GRAHAM, INC. Professional Ground-Water Consultants Northpark Corporate Center 1210 W. County Road E, Suite 700 St. Paul, MN 55112 (612) 490-1405	DAYTON THERMAL PRODUCTS PLANT DAYTON, OHIO
			SOIL-VAPOR EXTRACTION PILOT TEST SCHEMATIC
			FILE: 3CHDA02V.DWG DATE: NOVEMBER 1997 FIGURE: 9



NOT TO SCALE

DATE	REVISED	Prepared By:	DAYTON THERMAL PRODUCTS PLANT DAYTON, OHIO
		LEGGETTE, BRASHEARS & GRAHAM, INC. Professional Ground-Water Consultants Northpark Corporate Center 1210 W. County Road E, Suite 700 St. Paul, MN 55112 (612) 490-1405	AIR SPARGING PILOT TEST SCHEMATIC
			FILE: 3CHDA02V.DWG · DATE: NOVEMBER 1997 · FIGURE: 10